University of Alberta

School Injuries: A Descriptive Study of Edmonton Catholic Schools from 1987 to 1993

by

Sharon Frances DeLalla

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Master of Health Services Administration

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled School Injuries: A Descriptive Study of Edmonton Catholic Schools from 1987 to 1993, submitted by Sharon Frances DeLalla in partial fulfillment of the requirements for the degree of Master of Health Services Administration.

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Brian D. Fisher

Louis H. Francescutti

September 9th 1996

For Table 1

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Abstract

This study reports findings from a retrospective analysis of Edmonton Catholic School Board Accident Report Forms for the calendar years 1987, 1989, 1991 and 1993. The overall school injury rate was 4.11 injuries per 100 student-years. Elementary students, with 4.70 injuries per 100 student-years, reported higher rates than junior and senior high school students. Grade 6 had the highest rate of any grade, at 5.93 injuries per 100 student-years. Elementary students were injured most often on the playing field/tarmac and in the playground during recess and noon hour; junior and senior high students were injured more frequently in the gymnasium during physical education instruction. The most frequently injured body region was the head. Head injuries occurred at a higher rate in elementary students compared with those in junior and senior high. Junior and senior high students incurred higher rates of injuries to their fingers, ankles and knees. Bruises and lacerations were the most common types of injuries overall; serious injuries accounted for 39.0% of all injuries. Approximately 50% of injured students were transported for medical assessment.

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LIST OF ABBREVIATIONS

Grade Definitions

ECS	Early childhood (Kindergarten)
LC	Learning Centre for slow learners
EE1	Dependent mentally handicapped
EE2	Trainable mentally handicapped
EE3	Special needs (handicapped physically and/or emotionally; learning disabled)

General

ARF	Accident Report Form
ECSB	Edmonton Catholic School Board
P.E.	Physical education instruction
Sp.Ed.	Special Education students

Chapter 1

INTRODUCTION

Injuries are the most important threat to the health of children in industrialized countries and in a growing number of developing countries (Pocknall, 1993). In Canada, injuries and their adverse effects are the leading cause of mortality for children ages 1 to 14, accounting for approximately 45% of all deaths. More childhood mortality results from injury than from the combined number of deaths due to cancer, infectious diseases, birth defects, and diseases of the respiratory and nervous system (Health Canada, 1994). Injury is the leading cause of hospitalization for children ages 5 to 14 (Canadian Institute of Child Health, 1989). In 1986, childhood injuries accounted for 428,000 hospital days at an estimated direct cost of $176 million (Health Canada). In the United States, injuries are the most important cause of mortality and long-term disability in children over one year old (Grossman & Rivara, 1992; Stylianos & Eichelberger, 1993). Among school-aged children, unintentional injuries account for the highest rates of mortality and morbidity (Lenaway, Ambler & Beaudoin, 1992). The issue of childhood unintentional injuries is of particular concern in Canada. According to the Canadian Institute of Child Health, a 1985 international comparison of injury death rates for school-age children showed that Canada ranked 8th of the 9 developed countries studied; Canada's rate of 12.5 deaths per 100,000 children was substantially higher than those of Sweden, the Netherlands and Japan (Canadian Institute of Child Health) (see Table 1). Despite these statistics, research

into the area of childhood injuries and their concomitant prevention has been slow to emerge in Canada.

Table 1

Injury Mortality Rates for Children Aged 5 - 14: Canada and Selected Countries

Country	Rate (per 100,000)
Sweden	6.0
Netherlands	6.5
Japan	6.8
England/Wales	7.0
Germany (FRG)	9.5
Australia	11.0
France	11.0
Canada	**12.5**
United States	13.5

Note. From The Health of Canada's Children (p. 59) by Canadian Institute of Child Health, 1989. Reprinted by permission.

While data on the serious consequences of childhood injuries has been slowly growing, especially over the last 10 years, very little research has been done on injuries that children sustain while attending school. When one considers that children and adolescents spend approximately 7 hours per day at school (not including extra-curricular activities), their time at school is equivalent to adults' time at their places or work. Occupational injuries in adults have garnered much attention and have become a burgeoning area of research over the years; organized labor, as well as

occupational health and safety commissions, now attempt to ensure that preventable workplace/occupational injuries are not repeated. School-based injuries in children, on the other hand, have received very little attention. If data on school-based injuries isn't being collected, it follows that data-driven organized prevention of these injuries is not being undertaken. With school being the workplace of our children, it is both surprising and disturbing that injury research has neglected this very fundamental and important area.

One of the main reasons for studying school injuries, or any type of injury, is to provide an epidemiological basis for the design of prevention interventions. The necessary first step is to collect baseline data. This baseline data aids in the identification of the at-risk population(s) and injury issues for which prevention strategies can then be developed; as well, baseline information provides data against which post-intervention numbers can be compared. In terms of school-based injuries, it is imperative to know what types and how many injuries are occurring and to what students, where they are happening, the severity of the injuries, and injury patterns in school settings, before embarking on a prevention plan. Knowledge of the high risk student groups and the circumstances surrounding injuries will identify target groups of students (i.e., the student population at risk) and target activities at which prevention programs can be aimed.

Currently, the incidence of school related injuries in Edmonton is unknown. According to the *Childhood Injury Control Newsletter*, it is estimated that 200 injuries per school month are reported to the Edmonton Public School Board (Edmonton Board of Health, 1993). However, these

injuries are identified for insurance purposes; there is no reporting system that takes the injury records and synthesizes the information. The Edmonton Catholic School Board (ECSB) also keeps a record of each injury sustained to a student while at school or within a setting where the school is responsible for the student (e.g., field trip, sporting event). An Accident Report Form is completed for all injuries and the form is sent to the School Board office, where they are stored for insurance purposes. Again, like in the public school setting, there is no systematic analysis of the Accident Report Forms by the ECSB, hence the overall injury circumstances are unknown.

The term *accident report form* in itself brings up an interesting issue—the idea of *accident* versus *injury*. *Accident* implies that something happened unexpectedly, without known or assignable cause; in other words, accountability is difficult to determine and assess. *Injury* indicates that some kind of harm or distress has been suffered by an individual either unintentionally or intentionally; causality is not a part of the definition. Within the realm of injury research and prevention, the word *accident* is seldom, if ever, used. If cause, or reason, for the accident cannot be assigned (by definition), then prevention of the event is virtually impossible. Injury research focuses on the idea that people interact with their environment and this relationship does, at times, lead to a harmful event. When this relationship is studied, causality of the injury can be determined; it is this causality—both understandable and predictable—that becomes the foundation on which prevention strategies are built.

> The most important step in preventing injuries is overcoming a sense of fatalism, that injuries are "accidents" or random events that cannot be predicted. Fatalism holds that events are fixed for all time in such a manner that individuals are powerless to change them (Stylianos & Eichelberger, 1993, p. 1359).

Injury control or prevention is the science of minimizing the burden of injury on a population. As outlined, injuries are not random events but occur in predictable, understandable patterns. Haddon proposed a multifaceted, multidisciplinary approach to reduce the likelihood of childhood injury almost three decades ago. The Haddon matrix, a model for understanding injury causation, divides an injury occurrence into pre-event, event and post-event phases. Within each phase are aspects of the host, agent, and environment (both physical and social) which can be examined for their role in controlling injury occurrence and reducing injury loss (Haddon, 1968). Haddon's matrix can be very useful in considering ways to intervene in an injury problem. Much of the prior research in the field had focused exclusively on host factors in the pre-event phase. This matrix shows that these factors are only part of a much larger matrix of injury causation (Grossman & Rivara, 1992). Prevention can occur once the appropriate reason for the injury incident has been established.

Strategies for injury control and prevention can be broken down into three key areas: (a) Persuade and educate individuals (in the case of children, both parents and the child) to change their behavior by either stopping a hazardous activity or adopting the use of a prevention measure; (b) require individuals to change their behavior through legislation or

regulation; and (c) modify the product or environment to provide passive, automatic protection to the individual (Grossman & Rivara, 1992). These three types of interventions can be described as being either active or passive (or both). Active intervention requires a behavior change on the part of the individual (e.g., wearing a bicycle helmet); in other words, an individual is actively involved in reducing their likelihood of injury. Passive methods alter the environment for the individual thereby reducing injury situations (e.g., altering product design to make it more safe). While passive protection by modification of the product or environment is likely to be the most effective for certain types of injury situations, few injuries lend themselves solely to this type of approach. Thus, injury control strategies can be classified as educational, legislative, and/or environmental. The first two types of strategies require interventions that are active, while the third is passive. Often, the most effective injury prevention initiatives are a combination of these measures.

As earlier noted, prevention plans cannot be formulated and initiated until data on the specific injury field is available. This then leads to a return to the area of school-related injuries. Currently, the incidence and circumstances of childhood injuries taking place in Edmonton schools is unknown; what is known is that injuries are occurring. The Edmonton Catholic School Board has 7 years of Accident Report Forms (ARFs) which were made available to the author and will form the basis of this study. The goal of this research is to describe the pattern of injuries occurring in students attending Edmonton Catholic schools. The data will then help delineate the strategies for prevention—if and where they are required—

within the Catholic school system. The specific research objectives or questions are:

1. Over the past 7 years, what was the incidence of school-related injuries for elementary, junior and senior high students within the Edmonton Catholic School system?

2. Under what circumstances did school injuries occur?

3. What was the nature (diagnostic pattern, anatomical distribution) of these injuries?

4. How were these injuries treated?

Knowledge about the incidence and circumstances of injuries occurring in and around schools will contribute to the growing area of childhood injury research. By having an understanding about the pattern of injuries taking place, appropriate prevention and control initiatives can be developed. Preventing school-related injuries will make the students' experiences at school more productive and enjoyable, will reduce time absent from school, and will reduce the rate of temporary and permanent disabilities. Additionally, by reducing the number of school injuries, a concurrent reduction in the costs to the Alberta health care system for treating these injuries will occur. While there are many benefits to reducing the number and severity of school-related injuries, none is more important than simply ensuring that children are as safe as possible while attending school.

Chapter 2

LITERATURE REVIEW

Despite the importance of childhood injury research, there have been few published studies with respect to injuries occurring at the child's workplace—school. Children spend approximately 7 hours a day in the school setting, but how safe they are in this environment is generally unknown. These institutions intuitively appear to be a good location for the study of childhood injuries.

A literature search was conducted to gather published research on school injuries. The Medline database was used for the years 1968 to 1995. The search strategy involved cross-referencing (a) *school*, *school-related*, *school-based*, *student*, *children*, and *paediatric*, with (b) *injuries*, *accidents*, *trauma*, *prevention*, *health*, and *epidemiology*. References from pertinent articles were reviewed and further manuscripts gathered. The Edmonton Board of Health provided information on preliminary studies which they had undertaken with respect to school injuries, and provided correspondence with other school injury researchers in Canada (namely, those in Hamilton, Ontario and Vancouver, B.C.).

The earliest identified published study to report on school injuries looked at injuries to elementary school students (Kindergarten to Grade 6) in Columbia, Missouri (Dale, Smith, Weil & Parrish, 1969). This was a retrospective analysis of school accident report forms for the academic year 1968-69. The authors state that ". . . an accident did not have to produce a detectable injury to be reported . . ." (p. 294); thus, their definition of

reportable injury was fairly vague. A total of 409 school injuries were reported among the 5,485 elementary students, for a rate of 7.45 injuries per 100 students per school year. Boys sustained 237 (58%) of the injuries of the injuries and girls 172 (42%). These numbers for boys and girls reflect their proportion of the total injuries; the paper does not indicate rates based on the populations of boys and girls.

Dale et al. (1969) indicate that 7-year-old children were the ones most frequently injured, with 87 injuries; corresponding to this, students in the second grade had the highest number of injuries. Again, their values were based on gross numbers, with the denominator data absent. They found that March (72 injuries) and October (62 injuries) were the two months with the highest number of injuries; this was accounted for by March bringing the return of warm weather so children could be outdoors more, and October being the first full month of school. In terms of time of day, 73% of the injuries happened during three periods of the day: morning recess (10:00-10:59), lunch period (12:00-12:59), and afternoon recess (2:00-2:59). Most injuries—77%—happened on playgrounds; 9% occurred in the gymnasiums, and 5% in classrooms. Unorganized play accounted for 35% of the injuries and 14% of the students were injured when they fell from playground equipment.

The anatomical distribution of the injuries showed the head or face accounting for 64%, upper extremities 17%, and lower extremities 14%. About 75% of the injuries were described as mild; 25% were moderate or severe. Of the 409 injured students, 17% went to physicians' offices for treatment and 14% were taken to hospitals.

The first Canadian study to look at school injuries was done by Woodward, Feldman, Feldman, Hodgson and Milner (1983) at McMaster University during the 1981-82 school year. The McMaster study was a four-part analysis of school injuries.

The first part of the McMaster study was a prospective analysis of the incidence, types, related factors and initial management of school injuries (Feldman et al., 1983). Their study population was comprised of all students attending the 212 schools in the regional municipality of Hamilton-Wentworth, Ontario (three publicly-supported school boards with a combined enrollment of 83,692 children). All schools used a common School Accident Report Form (SARF) which had been developed by the research staff. The injury types were indicated on the SARF. Serious injuries were defined as fractures, loss of consciousness, dislocations, sprains, torn ligaments or cartilage, chipped or broken teeth and internal injuries. Minor injuries included scrapes, bruises, cuts, swellings or bumps, nosebleeds, and "other".

Following their normal (routine) reporting procedures, the schools submitted 4,298 SARFs resulting in an annual rate of 5.4 injuries per 100 school children per school year (Feldman et al., 1983). Boys had significantly more injuries than girls at both the elementary and secondary levels (6.3 vs. 4.4 per 100 students). Injuries were more common at the elementary level (6.3 vs. 3.8 per 100 at the secondary level). The majority of injuries (71%) were classified as minor with the remaining 29% being serious. Grades 6 to 8 were the peak injury years for both serious and minor injuries. While boys suffered significantly more injury events than girls, the

rates of serious injuries were similar in the two groups (1.6 vs. 1.4 per 100, respectively). However, the rates of minor injuries differed greatly between boys and girls (4.5 vs. 2.9 per 100, respectively). The injury events were distributed evenly throughout the school week with the number of events peaking during lunch hours and recesses. Athletic activities were the major cause of both serious and minor injuries, with half of all serious injuries occurring during supervised athletic activities. The part of the body most frequently injured was the hand, including the fingers, accounting for 17.8% of the minor and 26.6% of the serious injuries. For minor injuries, the head was the most commonly injured body part (28.7%). The schools were unable to give much information on the subsequent treatment and recovery of injured students other than to say that first aid was given in 61.6% of cases (more often for minor than serious injuries).

The second part of the McMaster study attempted to ascertain the extent of under-reporting of injuries by schools. To accomplish this, a subset of 50 schools was randomly chosen from the 212 schools (stratified by school board and educational level) to participate in the "all-report" condition (Woodward et al., 1984). These 50 targeted schools were requested to complete an accident report form (the same SARF used for routine reporting) for every injury, no matter how minor, that occurred during a school-sponsored activity. The target schools, under the all-report conditions, recorded injuries at a rate of 24.5 per 100 children per school year, or, in other words, four times higher than the rate generated by the schools under routine reporting. Accounting for the difference in the overall level of reporting, about twice as many serious injuries were reported during all-

reporting compared to routine reporting condition, as well as over five times as many minor injuries. While boys continued to have a higher incidence of injuries than girls, with all-reporting the magnitude of the difference decreased markedly. The proportion of serious injuries to boys (12.3%) and girls (13.6%) was similar in the all-report condition indicating that the increase in reporting of minor injuries didn't affect this outcome (Woodward et al., 1984). For the all-report group, the incidence of injury peaked in the third and fifth grades. However, under both reporting conditions the rate of serious injury is highest in Grades 6 to 8.

The third part of the McMaster study was undertaken to gather details on the treatment and follow-up of injured students. To accomplish this, parents of children in target (i.e., all-report) schools were contacted by telephone or mail, as schools did not adequately record post-injury treatment events. Parents were asked about the treatment of the injured children at school (if first-aid was given) and at home (whether health professionals were consulted or x-rays taken), as well as about their recovery (Hodgson, Yacura, Woodward, Feldman & Feldman, 1984). In general, schools and parents tended not to agree with respect to treatment received by the students. In the case of first-aid administration at school, parents differed from schools in 27.7% of cases. In 17.6%, the parents reported the administration of first aid whereas the schools did not. In 10.1% of the cases, parents failed to report first aid while the schools did. Parents reported a higher rate of medical consultations than the schools (19.1% vs. 7.4%). Agreement between parents and schools was generally low, with the disagreement mainly due to schools failing to report medical consultations.

The health professionals most commonly seen by children were physicians. Approximately 15% of the parents indicated that their child missed school for an average of 2.6 days. Additionally, the follow-up interviews with parents (4 to 14 days following the child's injury) indicated that 76% of the injured children had recovered, with the average time for recovery being 3.2 days.

Parents were involved in a second way in the McMaster study. In each of the 50 target schools, a 10% random sample of students, stratified by homeroom, was drawn (Hodgson, Woodward & Feldman, 1984). The parents of children selected for the random sample were sent a one-page questionnaire. The questionnaire asked parents if their particular child had sustained any school-related injuries during the previous month. If their child had been injured at school during this period, parents were asked to record the number and types of injuries and their treatment. Parents of approximately 200 students were sampled during each of the 10 months of the school year. The total injury incidence rate was 15.3% for the 10-month school period, with the rate of injured children being higher in elementary schools, as opposed to secondary schools (17.5% vs. 12.3%). Parents categorized 70% of the injuries as being minor and 30% serious; however, at the high school level, parents reported an equal number of minor and serious injuries, while at the elementary level, 80% of the injuries were classified as minor. Athletic activities were cited by the parents as being the most common cause of school-related injuries, with falls being the next most frequent cause. Of the children injured at school, 21% consulted an outside health professional and 86.7% of the consultations were to a physician.

The McMaster research indicates that routine reporting of school-related injuries does not account for all serious and minor injuries, as both target (all-report) schools and parents noted significantly higher overall injury rates. In addition, schools are not a reliable source of subsequent treatment details; information on the sequelae of school-related injuries is best obtained from the parents. School reports tend to underestimate the number (and thus the cost) of medical consultations generated by school-related injuries.

The only other Canadian study on school injuries was done by Sheps & Evans (1987) in a collaborative effort between the Vancouver Health Department and the Vancouver School Board (VSB). This "School Injury Surveillance Project" retrospectively reviewed school injuries that occurred over a two-year period (1981-82 and 1982-83) in the municipal school district of Vancouver, British Columbia. The study population consisted of all students enrolled in 108 Vancouver School Board schools (92 elementary and 16 secondary). The sampling method was one of reviewing two years of routinely-collected Vancouver School Board Accident Report Forms (ARF) (Sheps & Evans, 1987). The criteria for completion of this form by the schools (or health department staff) were if a child sustained or required any of the following: all head injuries, suspected or definite fractures, use of ambulance or inhaler, referral to a physician or dentist, sutures, or a foreign body in the eye. All the measurements were made from data collected on the ARF. Severe injury was defined by the nature of the injury: fractures, loss of consciousness, burns, whiplash, foreign body in the eye, and open wounds.

The two-year study period reported an overall injury rate of 2.82 per 100 students per school year (3009 injuries in 106,718 students), with elementary school students (Kindergarten to Grade 7) having a slightly higher rate than secondary school students (2.85/100 vs. 2.78/100 students, respectively). In terms of severity, 39% of all secondary and 35% of elementary school students' injuries were severe. In this study, injury rates peaked for junior high students in Grades 7 to 9. For elementary school students, the playground was the location with the highest occurrence of injury (1.09/100); this rate was more than twice as high as the next most frequent site which was sporting areas (0.48/100). For secondary school students, sport areas (0.79/100) and classrooms (0.63/100) had the highest incidence of injuries.

In terms of cause of injury, falls and striking mechanical or other objects were the cause of more than half of the injuries reported both overall and for elementary school students. Sports injuries occurred three times more often in secondary school students than among elementary students. Contusions, abrasions and swelling were the most frequently reported injuries; however, they occurred twice as much in elementary school students than in secondary school students. Sprains, strains and dislocations, in contrast, occurred at almost twice the rate in secondary school compared to elementary school students, which was likely due to the higher incidence of sport-related injuries among secondary school students. Thus, consistent with the findings of the McMaster study, the Vancouver data indicate that elementary school students suffer minor injuries at a higher rate, whereas secondary school students have a higher rate of

serious injuries. The body part most often injured differed for elementary and secondary schools, with injuries to the head and neck being more prevalent among elementary students (1.39/100), and upper extremity injuries being the most frequent in secondary schools (0.93/100). Lower extremity injuries were fairly frequent in both groups, although higher in secondary school students (0.54/100 vs. 0.33/100 for elementary school students).

With respect to response to injury, while first-aid treatment was the most common response for both elementary and secondary school students, being sent to the hospital was more than twice as common for secondary school students (due to their higher rate of severe injuries).

It is interesting to note that Sheps and Evans (1987) indicate that their overall injury rate of 2.82/100 student-years is low compared to the McMaster study and state that this is likely a result of under-reporting (due to the retrospective nature of the study, they were unable to control for under- or over-reporting).

A second component to the Vancouver study is that they attempted to explore the impact of behavioral control on injuries in elementary schools. To do this, they analyzed injury rates in "controlled" and "uncontrolled" areas of the schools. Controlled areas were those parts of the school where there was both direct observation by teachers and a reasonable opportunity for intervention and control of student behavior (e.g., classrooms, organized sports events, etc.). Uncontrolled areas were those in which there may or may not be supervision, but the ability of the teacher to effectively intervene was limited due to factors such as large numbers of students or their spatial

distribution (e.g., playgrounds, hallways, washrooms, etc.). Their findings showed a relative risk of 6.3 for uncontrolled versus controlled areas of schools; in other words, when students are in uncontrolled areas of the school they are 6.3 times more likely to incur injuries than when they are in controlled settings. Based on this finding, the authors suggest that the concept of schools as social institutions influencing student behavior merits more exploration within the specific context of school injuries.

An American study done during the 1969-70 school year assessed student injuries due to aggressive behavior in Seattle public schools (Johnson, Carter, Harlin & Zoller, 1974). This descriptive study reviewed all student injuries reported in the public school system. Of the 2,560 reported injuries, 321 (13%) described injuries due to aggressive behavior. This represents a rate of 3.6 aggression injuries for 1000 children over the 180-day academic year. The aggression injury rate was much higher in the junior high grades (5.8 per 1000 children) than in the elementary grades (3.4 per 1000 children) or the senior high grades (1.7 per 1000 children). Boys at all grade levels had higher aggression injury rates than girls. Fighting was the leading cause of injury in senior high students (73%) and junior high students (55%), but for elementary students, pushing was the leading cause (45%), with fighting second (36%). For elementary students, 74% of aggressive behavior injuries occurred on the playground; the corridor was the most frequent injury location for senior high students, and the classroom was the site of the majority of injuries to junior high students. This study concluded that the problem of aggressive behavior and conflict in schools is an area that warrants further study.

Boyce, Sprunger, Sobolewski and Schaefer (1984) conducted a prospective study which documented injuries occurring in the Tucson (Arizona) Unified School District for two school years (1980-81 and 1981-82). The Tucson Unified School District is a large urban school district made up of 96 schools (75 elementary, 14 junior/middle, 10 high schools) and 55,000 students. Nurses in the schools completed the injury reporting forms.

The Tucson study reported an injury rate of 4.9 injuries per 100 students per school year. Boys accounted for 67% of the total injuries reported with adolescent boys (14 and older) having the highest number of injuries, accounting for 30% of all injuries sustained. Adolescent boys had an injury rate almost three times as high as their female peers. Athletics were the highest single cause of injury accounting for 23% of reported cases, while self-caused had a rate of 21%. In terms of location, 65% of the injuries occurred in the playground or gym.

In their analysis of relative risk, the authors found that girls were twice as likely to be injured on playground or sports equipment as boys. Boys were substantially more likely than girls to have been injured during athletic events. In terms of age, notable differences in risk include the disproportionate number of injuries related to playground equipment and accidental contact with other students among the youngest injury cases (aged 11 and younger). The high-school aged group was found to be five times more likely to sustain an athletic injury than their younger counterparts.

In terms of severity, 18% of all reported injuries were classified as severe. Analyzing relative risk of these severe cases, injuries related to the playground or sports equipment were 1.6 times more likely to have been severe when compared with all other apparent causes of injury. With respect to location, injuries occurring on the playground or in the gym were 1.8 times more likely to be severe.

Taketa (1984) undertook a retrospective analysis of the Student Accident Report Form for Hawaii public schools during the 1981-1982 school year. Of the 224 public schools statewide who participate in the school health program, data was collected from 204 schools. The study population consisted of more than 157,000 Kindergarten to Grade 12 students.

In Hawaii, a student accident, which must be reported on the Student Accident Report Form, is defined by the Department of Education as any accident which happens at school or at a school sponsored activity, on or off campus, which (a) interrupts the students' normal or expected activity for that period to any significant degree, (b) causes any property damage or losses of more than $5 in estimated replacement cost and/or (c) can generate a litigation on behalf of the injured (Taketa, 1984). All accidents interfering with a student's normal activity for a half day or more are defined as a temporary disability. The Student Accident Report Form is completed by the adult supervisor (teacher, principal, coach, support staff) of the activity or area where the accident occurs even if the adult supervisor does not witness the accident.

Taketa (1984) reported an overall incidence rate of 1.67 injuries per 100 students per school year. Boys were involved in 68% of the injuries, demonstrating a male to female ratio of 2.1:1. There were fewer injuries reported in the high school grades in comparison to the intermediate and elementary grades. Injuries peaked in the eighth (3.9% of the total eighth grade population) and sixth grades (2.4% of the total sixth grade population). The lowest reported number of injuries occurred in grades 11 and 12. Overall, children at the elementary level had a higher number of reported injuries in comparison to the intermediate and high school levels.

More injuries occurred during unorganized play or free time than during organized athletic programs (614 vs. 521, respectively). The playground accounted for 32% of the injuries overall; the athletic field or gymnasium was the site of 17% of the injuries and the classroom, where the student is supposedly closely supervised, was the location for 16% of the injuries.

Abrasions/lacerations and bumps/bruises accounted for approximately 65% of the injuries. Sprains and fractures made up 25% of the injury reports, with the remaining 10% involving other injuries such as burns, bites and stings. The most severe injuries were foreign bodies to the eye and fractures.

Forty-three percent of the injuries involved the head and neck area, the arms sustained 32%, legs 18% and trunk 7%. Thirty-two percent of the injuries resulted in the student having a temporary disability of a half school day or more; 49% required the student to be out of the classroom for 3 hours or less. In terms of the time of year, Taketa (1984) found that September and

October, the beginning months of school, and May accounted for the highest incidence of injury.

The most recent study on school-related injuries was done by Lenaway et al. (1992) on the Boulder Valley (Colorado) School District. These researchers undertook a prospective study for the one year period of 1988-89. The Boulder Valley School District is made up of a total of 40 schools with an annual total enrollment of approximately 21,000 students. Their prospective study sampled 9 schools representing 26% (5,518) of the students in the total school district population, and consisted of 4 elementary, 1 middle, 2 junior and 2 senior high schools which met specific inclusion criteria: demographic and geographic representativeness, a history of excellence in past reporting of injuries, and a high degree of interest in the objectives of the study. The inclusion criteria was established prior to data collection in order to increase the accuracy and uniformity of reporting by those responsible at each school. Data collection was done via the Report of Student Accident form.

For the 1988-89 study period, the injury incidence rate was 9.22 injuries per 100 students per school year. An overall relative risk of 1.41 indicated that a male student was almost 1 1/2 times more likely to have incurred an injury than a female student. Middle/junior high students overall sustained the highest number of injuries with a rate of 14.3 per 100 students. When injuries were analyzed by grade level, the Boulder Valley schools showed three distinct peaks: Grade 4 (17.6 per 100), Grade 6 (17.7 per 100), and Grade 8 (16.6 per 100). The playground was the most common location for injuries to elementary school students with a rate (6.12/100

students) three times higher than the next most common location (the gym). Playground equipment was associated with 38% of all playground injuries, producing a rate of 2.37 injuries per 100 students. Middle and junior high students were more likely to be injured on the athletic field or in the gym; for high school students, the gym accounted for a higher rate of injury than the athletic field.

Sports activity, which included both formally and informally organized sports, accounted for 53% of all reported injuries in the Boulder study. Grade level was directly related to the increase in the percentage of injuries associated with sports: 40% of elementary, 54% of middle/junior high, and 69% of senior high school injuries were sport-related. Football was the sport associated with the highest incidence of injury for both middle/junior and senior high students. Overall, males were at a greater risk from sport-related injuries than females at all grade levels. Cut/abrasion, swelling and general pain were the most common types of injuries reported for elementary school students. Middle/junior high school students had a higher rate of swelling injuries than the younger group and sprain/dislocation injuries in this group increased dramatically beyond the rate for elementary students. High school students were most likely to incur sprain/dislocation types of injuries.

With respect to the most common body sites injured, overall the wrist/hand/finger, the leg/knee, and the head were the most prevalent in decreasing order. Wrist/hand/finger injuries accounted for the highest injury rate among elementary and high school students, with the leg/knee being the most common site for middle/junior high students.

The six studies on the routine reporting of school injuries (two Canadian and four American) demonstrate strong similarities in their findings. While the rates of injury incidence vary from 1.67 to 9.22 per 100 students per school year, the methods of reporting (retrospective versus prospective) also varied, which likely accounts for some of the difference. Two of the three retrospective analyses, those in Hawaii and Vancouver, reported the lowest rate of school injuries. The findings by the McMaster group that under-reporting of school injuries appears to be common, based on their data from all-report schools and parent questionnaires (with annual rates of 24.5 and 15.3 injuries per 100 students per school year, respectively), indicates that injuries are occurring in schools at a higher than expected or reported rate. The findings from the six studies demonstrate that injuries happening in and around schools warrant further review.

Fothergill and Hashemi (1991) studied school injuries from a slightly different perspective when they reported on school injuries presenting to an Accident and Emergency (A & E) Department. The study comprised a 6-week period in April-May 1989 when information was obtained from 200 consecutive patients who were students injured in their educational establishments, and then who presented to the A & E Department of a university hospital in England.

Of the 200 students in the study, 68% were boys and the mean age was 11.4 years. More than one-quarter of the patients had been injured on a Wednesday. Overall, 3/4 of the patients presented to the hospital within 6 hours of the injury, but 11% did not attend until more than a day had

elapsed. There was a progressive rise with increasing age in the proportion of patients presenting to the A & E Department immediately after the injury. Eighty-four percent of those younger than 5 years were brought to the hospital by their parents, and this proportion fell progressively with increasing age.

Over half of the injuries occurred during free time at school, during which 51% of the patients reported being unsupervised. One-quarter of the injuries occurred during organized sport, where supervision was present in 88% of the cases.

Fifty-five percent of the injuries sustained were bruises, abrasions and sprains. Lacerations accounted for 22% of the injuries and, of these, 57% were to the scalp or face. The most serious injuries seen were fractures (33 in total for a rate of 16%), of which 9 occurred during sports and 19 during students' free time; 70% of the fractures were to the upper limb and 18% were facial. The majority of the patients seen in the A & E Department required no treatment other than dressings and advice; 18% of the patients required suturing, 11% manipulation and/or splintage for fractures, and 5% required operations.

The Fothergill and Hashemi (1991) paper is the only study that employed hospital records as the tool for assessing school injuries. Because students were referred to as being from either senior schools or junior schools, it is impossible to make comparisons with respect to grade level or age as this information was not supplied. Interestingly, a playground injury rate was not given, although the authors did state that playground equipment was involved in only two of the presenting cases. In the North

American studies, the playground is consistently a location where many injuries occur. Possible explanations for this difference are that playground injuries aren't serious enough to warrant a visit to the A & E Department, or that the student's weren't asked to expand on where they were when they were injured during their "free time".

The final paper by Evans and Sheps (1987) explores the problem of measuring the severity of school injuries and in it the authors make two important points. First, they identified that a major problem in drawing conclusions from the current school injury literature revolves around the lack of standardization in categorizing serious injuries. The studies typically define severity using a priori criteria based either on the nature of injury or body area injured. They found that cross-study comparability of severe injuries was very limited due to the varying inclusion criteria. Furthermore, minor injuries are generally not defined except by exclusion. The authors suggest that these are methodological concerns which future researchers should address.

Second, the Evans and Sheps (1987) manuscript proposed that, from the schools' perspective, it is not the severity of the injury which should be assessed—what is important is making the appropriate medical referral. They submit a list of descriptors which not only defines what happened (e.g., head injury with or without loss of consciousness), but also, and importantly, includes descriptors of the child's functional state shortly after the injury is sustained in terms relevant to a non-medical assessor (e.g., unable to move leg without pain or limitation of motion). The purpose of the list is to act both as a tool for schools to better assess the injured student, as

well as a starting point for further research. Interestingly, this paper appeared in 1987, and to date no manuscripts have appeared which address either of these issues.

Children's Hospital Injury Research and Prevention Program (CHIRPP) is a Health Canada initiative which collects information on injuries to children under 15 years of age who present at 10 paediatric and 2 general hospitals across Canada. Between April 1990 and June 1993, there were a total of 34,181 records of childhood school injuries seen at the participating hospitals (Edmonton Board of Health, 1993). The CHIRPP data showed that over 50% of the injuries occurred to children between the ages of 10 to 14 and approximately 33% were to children in the 5 to 9 age group. Boys sustained about 57% of the overall total number of injuries. During school time, injuries were most often sustained between the hours of 12:00 to 1:00 p.m., which corresponds with lunch hour, and many of these happened on the playground. A significant number of injuries were also recorded as having occurred after school hours.

Sport activities, especially basketball, soccer and football, accounted for 43.7% of the injuries; play or recreation was the next most common activity at 30.9%. Sprains or strains, especially of the ankle, were the most frequently sustained injuries, followed by fractures. Furthermore, 35% of the sprains or strains were sport-related as compared to 19% for all school-related injuries excluding sports.

Of the total number of injuries, 3.4% (1170 children) required admission to a hospital. The main cause for admission was fractures, especially of the upper limb, and these admissions were most commonly the

result of play or recreation (46%) and sports (29%). Treatment in the Emergency Room with a recommendation for a follow-up visit was needed by 38.9% of the injured children. The Edmonton Board of Health *Newsletter* was the only source found which synthesized the school-based portion of the CHIRPP database; this data was given to the Edmonton Board of Health by CHIRPP on a special request.

Table 2 presents a summary of the published school injury studies done to date.

Table 2

Summary of Findings from 10 School-related Injury Studies

Site, Study Authors, & Date	Study Population	Study Type (Data Collection Method)	Results (Major Findings)
1. Columbia, MO, Dale et al., 1969	All elementary students (5485) in Columbia, MO	Retrospective	- 7.45 injuries/100 students - boys: 58% of injuries; girls: 42% of injuries - 7-yr.-olds (Grade 2) most frequently injured - times accounting for 73% of injuries: 10:00 - 10:59; 12 - 12:59; 2 - 2:59 - 77% of injuries in playground - 35% occurred during unorganized play - 64% of injuries to head/face - 75% mild; 25% moderate/severe - 17% physician visits; 14% to hospital

(table continues)

Site, Study Authors, & Date	Study Population	Study Type (Data Collection Method)	Results (Major Findings)
2. Hamilton, ON, Feldman et al., (McMaster Univ.), 1983	All students in 212 schools in district	Prospective analysis	- 5.4 injuries/100 students - 71% minor; 29% serious - minor injuries boys: 4.5/100; girls: 2.9/100 - serious injuries boys: 1.6/100; girls: 1.4/100 - elementary: 6.3/100; secondary: 3.8/100 - athletics major cause of all injuries - hand most injured body part - head had most minor injuries
3. Hamilton, ON, Woodward et al., (McMaster Univ.), 1984	Students in 50 target schools	Prospective (all report condition)	- injury rate of 24.5/100 students
4. Hamilton, ON, Hodgson et al., (McMaster Univ.), 1984	Parents of students in 50 target schools	Retrospective (parents asked about treatment of injured child)	- parents differed from schools in 29% of cases re first aid given - parents reported higher rate of medical consultations (19.1% vs. 7.4%)

(table continues)

Site, Study Authors, & Date	Study Population	Study Type (Data Collection Method)	Results (Major Findings)
5. Hamilton, ON, Hodgson et al., (McMaster Univ.), 1985	Parents of students in 50 target schools (10% random sample)	Retrospective (asked if their child was injured in previous month)	- 15.3% of students injured per month - rate higher for elementary than secondary (17.5% vs. 12.3%) - 70% minor; 30% serious - 21% of injured students saw health professional; 87% of consultations sent to doctors
6. Vancouver, BC, Sheps & Evans, 1987	All students in Vancouver School Board schools	Retrospective	- 2.82 injured/100 students - elementary: 2.85/100; secondary: 2.82/100 - playground most frequent location for elementary students - sports areas & classrooms most common location for secondary students with sports most common cause of injury - contusion, abrasion, swelling most frequent injuries; rate doubled for elementary students - sprain, strain, dislocation twice as common for secondary students - head & neck most injured body part in elementary: (1.39/100) - upper extremity most injured body part in secondary: (0.93/100) - relative risk of 6.3, uncontrolled vs. controlled areas of school

(table continues)

Site, Study Authors, & Date	Study Population	Study Type (Data Collection Method)	Results (Major Findings)
7. Seattle, WA, Johnson et al., 1974	All students in public school system	Retrospective	- injuries due to aggressive behavior: .36/100 students over 180-day academic year - 13% of all report injuries due to aggressive behavior
8. Tucson, AZ, Boyce et al., 1984	All students in Tucson Unified School District (96 schools)	Prospective	- 4.9 injuries/100 students - 67% of injuries to boys: adolescent boys accounted for 30% of all injuries - athletics caused 23% of injuries - 65% of injuries occurred in gym or playground - 18% of injuries were severe
9. Hawaii, Taketa, 1984	204 of 224 public schools statewide; study population >157,000 students in Grades K - 12	Retrospective	- 1.67 injuries/school year - male: female ration = 2:1 - most injuries in Grades 6 & 8; overall, elementary students had more injuries - 32% of injuries in playground - 65% of injuries: bumps/ bruises & lacerations/ abrasions - 43% of injuries to head/neck; 32% to arms

(table continues)

Site, Study Authors, & Date	Study Population	Study Type (Data Collection Method)	Results (Major Findings)
10. Boulder Valley, CO, Lenaway et al., 1992	All students in sample of 9 schools (26% of total school district population)	Prospective	- 9.22 injuries/100 students - relative risk of 1.4 for males - middle/junior schools had highest injury rate: 14.3/100 students - playground most frequent location for elementary students: 6.12/100 - playground equipment related to 38% of playground injuries - athletic field & gym most frequent location for junior/senior high students - sports activity cause of 53% of all reported injuries - cut/abrasion, swelling primary injury type in elementary - swelling, sprain, dislocation main injury type in junior high - dislocation, sprain main injury type in senior high - wrist/hand, leg/knee & head most frequent injured body regions

Chapter 3

METHODS

Overview of Design

This study is a retrospective, longitudinal, descriptive study of Accident Report Forms from the Edmonton Catholic School Board. The study design involves the analysis of 4 years of the forms (years 1987, 1989, 1991 and 1993). Four thousand and seven (of approximately 7000 available) forms were entered directly into an EpiInfo database for subsequent analysis.

Study Subjects

Edmonton, Alberta is an urban center in the northern part of the province with a population of approximately 725,000. The city is socially, economically and demographically diverse, having a centrally located city center surrounded by suburban neighborhoods.

The study population was comprised of all students who were enrolled with the Edmonton Catholic School Board at all grade levels—Kindergarten to Grade 12—including the special education classifications of LC, EE1, EE2 and EE3 students (definitions in List of Abbreviations) in the 1986-87 to 1993-94 school years (complete calendar years 1987 to 1993). In 1993, the ECSB was made up of 85 schools (53 elementary, 13 elementary/junior, 10 junior, 2 elementary/junior/senior, 1 junior/senior,

and 6 senior high schools) located in all parts of Edmonton. Due to school closures and openings, the number of schools involved varied across the study years: (a) 1987 had 80 schools, (b) 1989 had 81 schools, (c) 1991 had 83 schools, and (d) 1993, as identified above, was made up of 85 schools. It should also be noted that 3 schools closed between 1987 and 1990; data from these schools were not included in the analysis as adequate enrollment data was unavailable. The ECSB had approximately 30,000 students per year enrolled in their schools during the study period. The study sample consisted of all students who sustained a school related injury for whom an Accident Report Form was completed during the calendar years 1987, 1989, 1991 and 1993.

Measurements

The ECSB Accident Report Form (ARF) serves the purpose of reporting all injuries incurred by students within the school setting or during school-sponsored activities (see Appendix 1). While the form was revised in 1992, the revisions were purely aesthetic in nature and the content was unchanged; thus, the same form was in place for all of the study years.

The top portion of the ARF is comprised mainly of student information—school, date form completed, name of student, student identification number, Alberta Health Care number, age, grade, gender, and date and time of accident. Of these, the school, grade, age, and gender were the demographic data gathered. The date form completed and date and time

of accident components were entered as information relating to the injury circumstance. The remainder of the ARF consists of eight categories/questions about the injury circumstance, six of which are closed-ended, one is open-ended (brief description of accident), and one has both closed and open-ended components. This largely closed-ended format made the form very amenable to easy coding for data entry.

Thus, the measurements supplied by the ARF that will form the basis of this study are as follows:

1. Demographic data
    (a) age
    (b) gender
    (c) grade
    (d) school
2. Injury circumstance
    (a) date of injury
    (b) time of injury
    (c) place of injury (i.e., facility area)
    (d) program phase (e.g., class, recess etc.)
    (e) probable direct cause
    (f) activity at time of injury
3. Description of injury
    (a) type of injury (e.g., cut, fracture, etc.)
    (b) body region injured

4. What was done for the student

(a) parent notification

(b) transport to medical facility

(c) disposition of injured student

Injury severity is a measurement which is often tabulated in school injury studies, based on the information obtained from the injury reporting form. However, injury severity is a somewhat arbitrary measure, since the definition of serious injury can and does vary depending on who is doing the classifying. To date, none of the school injury studies have had a consensus on what they consider to be serious and minor injuries. The author consulted the McMaster study (Feldman et al., 1983), which was the most comprehensive of all the school injury research, and adapted their list, using it as the model, to come up with categories of serious and minor injuries. This adaptation was necessary as not all "type of injury" classifications used in this research were utilized in the McMaster study; additionally, slightly different injury identifiers were present on the different reporting forms (e.g., loss of consciousness versus concussion—temporary loss of orientation or unconsciousness). The injury types classified as serious in this study include: burn, concussion, dislocation/separation, fracture, muscle strain (pull or tear), sprain, loose or broken teeth, and fainting/passed out/shock. Minor injuries are: abrasion, bruise, laceration/incision/puncture, nose bleed, pinching (of skin, appendage), winded/dizzy, eye irritation/double vision, headache/bump on head/general head soreness, no visible injury or complaint by student, no visible injury—pain only (no clear injury type), and "other."

Pilot Study

The purposes of the pilot study were to: (1) obtain an approximate count of the number of Accident Report Forms (ARFs) completed per year; (2) review the ARFs for completeness; and, (3) review the ARFs for coding purposes, especially those parameters which had an "other" category. To determine the approximate number of ARFs completed each year and the rate at which injuries were occurring, a count was made of the number of ARFs completed for 1991 and 1992. It was found that the forms were compiled for calendar years (i.e., January to December, excluding July and August) and not school years (i.e., September to June). Since the 10-month school period was covered, this was not an issue in the calculations; however, adjustments were necessary. Student enrollment was, of course, compiled on a school year basis.

From this pilot survey, it was determined that four years of forms could be computerized, given the available time. Because the ARFs were collected by calendar year, it was decided to analyze the data by calendar year rather than by school year. This entailed adjusting the denominator data (enrollments), which was provided on a school year basis for the calculation of rates. Using the numbers from 1991, an example follows:

1991 Total injuries = 1034

1990/1991 Total enrollment = 29,902

1991/1992 Total enrollment = 30,739

$$\text{Rate of injury in 1991} = \frac{1034}{(0.6 \times 29{,}902) + (0.4 \times 30{,}739)}$$

(where 0.6 represents January - June (6 months) and 0.4 represents September - December (4 months))

= 3.42 injuries per 100 students per calendar year.

Using this same methodology for 1992, where there were 1169 Accident Report Forms completed, 30,739 students in 1991/1992, and 31,748 students in 1992/1993, the injury rate is 3.75 injuries per 100 students per calendar year. All of the rates reported in this research, whether by year, school level or grade level, will employ this same calculation methodology, using enrollment-adjusted denominators.

During the review for completeness, it was determined that the majority of the Accident Report Forms were completed fully and with reasonably good descriptions of the injury incident. The grade number and age were the categories most often missing, and, the majority of the time, one of the two were recorded.

One hundred and sixty-nine forms (50 from 1990, 48 from 1991 and 71 from 1992,) were randomly chosen to determine the proportion of forms which indicated that more than one body region was injured. Of the 169 forms, 20 recorded two or more injured body regions for a rate of 11.8%. A total of 7 reports indicated three or more body regions injured, for a rate of 4.1%. This means that for a school year where 1000 ARFs are completed,

approximately 118 forms will report injury to two or more body regions and 41 will report injury to 3 or more body regions. It was found that where two injured body parts were reported, the description of the injury incident usually allows for the determination of what type of injury occurred to what part (e.g., cut to knee and bruise on head). Where three or more body parts are identified, it becomes very difficult to determine which injury type corresponds to what body part. Therefore, due to the limitations of data entry, injury type and body part are unable to be linked for multiple injuries.

The other purpose of the pilot study involved reviewing the completed ARFs for coding purposes. Specifically, the categories of Body Region(s) Injured, Type of Injury, Facility Area, Probable Direct Cause, Program Phase and Activity all had an "other" answer option for a written description when none of the identified classifications fit the injury incident. Two hundred ARFs (50 randomly chosen from each of the years 1990, 1991, 1992 and 1993) were reviewed for these "other" categories and the appropriate descriptions/codes were assembled.

The Accident Report Form identified 24 possible options for injured body regions; two categories, the tongue and predisposing conditions, were added based on the findings of the pilot study. Thus, there were 26 specific regions, as well as an "other" option. The "Type of Injury" component of the ARF describes the nature of the injury incurred by the student. The ARF itself lists 11 possible injury types, as well as an "other" classification; the pilot study resulted in nine more categories being added, including those for predisposing conditions and unknown injury types. Thus, a total of 20

specific type of injury classifications were possible, in addition to the "other" category.

The facility area identifies the geographical location where the student was injured. There were 16 possible categories including "other"; of these, nine appeared on the ARF and seven were added as a result of the pilot study. The program phase determines, at least generally, what the student was participating in at the time of the injury. There were eight possible categories, including one for "other", on the ARF; two categories were added, giving a total of 10 possible selections.

For activity at the time of injury, the Accident Report Form identifies 22 activities, including a miscellaneous category; 12 specific activities were added based on findings from the pilot study. Regular class instruction was one of the activity categories added after a review of the ARFs for the pilot study, since it was often identified in the space for miscellaneous. Under the probable direct cause of the injury section of ARF, there were 10 possible causes listed, including an "other" classification. Eight more "probable causes" were established through the pilot study, giving a total of 18 possibilities. The coding schemes for each category can be found in Appendixes 2 to 9.

Statistical Methods

There were 7 years of Accident Report Forms (approximately 1000 per year) available for this study. Of the 7 years, 4 calendar years (1987, 1989,

1991 and 1993) of Accident Report Forms were entered into an EpiInfo database for analysis, using an IBM-compatible portable computer. Only 4 of the 7 years of available Accident Report Forms were utilized due to the limitations of time. The years 1987, 1989, 1991 and 1993 were chosen to look for trends over the 1987 to 1993 time period. Once all of the data had been entered into the database, it was analyzed using EpiInfo software. The data was analyzed to answer the following questions:

1. What was the incidence of school-related injuries by year, by school level, and by grade level?

2. What were the circumstances under which school injuries occurred?

3. What was the nature of school injuries in terms of their anatomical distribution and diagnostic pattern?

4. What kind of treatment did the injured student receive?

Quality Control and Data Management

Missing data and inaccurate and imprecise data were a problem due to the retrospective nature of the study. The Accident Report Forms had been recorded over a seven-year period and the researcher was unable to resolve missing or imprecise information. The Edmonton Catholic School Board Accident Report Form is largely comprised of closed-ended questions which result in the data being more consistently reported; in other words, the reporting of the same variables using the same values. As a means of

improving the quality of the entered data, initial frequencies and cross-tabulations were run to detect outliers and other questionable numbers. The Accident Report Forms were then consulted and data entry errors were corrected.

Inter-observer variation was measured to assess the quality of the extraction of the data. A random sample of 35 Accident Report Forms were recorded twice, once by the researcher and once by a research associate, to determine the level of observer variation of entered data. The 35 forms each had 22 coded entries (or fields) amenable to a validation check; thus, 770 independent entries were cross-checked. There was a total of six mismatching fields found on analysis of the two files; the six mismatches were located in four separate records. In other words, 31 of the 35 (88.6%) recorded Accident Report Forms matched completely.

Chapter 4

RESULTS

The number of schools which supplied Accident Report Forms for the individual study years varied due to school openings and closures: (a) 1987 had 80 schools, (b) 1989 had 81 schools, (c) 1991 had 83 schools, and (d) 1993 had 85 schools. The total person-years of follow-up over the four study years (1987, 1989, 1991 and 1993) was 111,534; this total is comprised of 60,980 (54.7%) elementary student-years, 24,035 (21.5%) junior high student-years, and 26,518 (23.8%) senior high student-years. These population aggregates include the special education students who are enrolled in schools at all three levels; there were 5247 special education student-years incorporated into the numbers above.

A total of 4007 Accident Report Forms were entered into the database for analysis; 8 forms were not recorded due to insufficient information (only the school and student names were identified with no injury information whatsoever supplied). There were 24 ARFs in the database corresponding to three schools closed over the study period; the data from these schools were not included in the results as adequate enrollment information was unavailable, leaving a total of 3983 records for analysis.

Incidence of School-related Injuries

The overall school injury incidence rate for the study period was 4.11 injuries per 100 student-years. The overall injury rates for the individual study years can be found in Table 3.

Table 3

Average Overall Injury Rates by Study Year

Year	Rate (per 100 student-years)
1987	3.74
1989	4.08
1991	4.48
1993	4.31
Overall	4.11

The data shows that the rate of injuries increased steadily from 1987 to 1989 to 1991, and then decreased in 1993. The analysis of rates according to school grade levels identifies that the frequency for elementary students is higher than the overall study rate at 4.70 injuries per 100 student-years (see Table 4). Junior high students had an incidence of 3.63 injuries per 100 student-years; the senior high incidence was 1.94 injuries per 100 student-years. All of the above incidence rates incorporate the special education students into their appropriate school level.

Table 4

Average Overall Injury Rates by School Level

School Level	Rate (per 100 student-years)
Elementary	4.70
Junior High	3.63
Senior High	1.94

Note. Special Education students were incorporated into their appropriate school level for these calculations.

With respect to grade, 3835 ARFs had the grade level identified giving a completion rate of 96.3%. Grade 6 students had the highest number of recorded ARFs with 472 (12.3%); this also corresponded to the grade with the highest rate of injury at 5.93 injuries per 100 student-years (see Table 5). Grade 5 resulted in the second highest number of ARFs at 449 (11.7%)

Table 5

Injury Numbers and Rates by Grade

Grade	No. of Injuries	Student Population (student-years)	Injury Rate (per 100 student-years)
Kindergarten	167	5,009	3.33
1	394	10,130	3.89
2	295	9,450	3.12
3	380	8,927	4.26

(table continues)

Grade	No. of Injuries	Student Population (student-years)	Injury Rate (per 100 student-years)
4	393	8,573	4.58
5	449	8,325	5.39
6	472	7,963	5.93
7	306	8,238	3.71
8	228	7,886	2.89
9	292	7,540	3.87
10	193	7,866	2.45
11	133	7,184	1.85
12	80	9,194	0.87
Total	3,835	111,534	

and also the second highest rate of injury at 5.39 injuries per 100 student-years. Generally, the trend is for injury rates to rise as grades increase until Grade 6, except for a down-turn in Grade 2. After Grade 6, injury rates fall steadily until Grade 12 with the exception of Grade 9 which showed a fairly marked increase. When the grades are grouped (ECS-3, 4-6, 7-9, 10-12), the Grade 4 to 6 block has the highest rate of injury at 5.29 injuries per 100 student-years (see Table 6).

Table 6

Average Injury Rates by Grade Groups

Grades	Rate (per 100 student-years)
Kindergarten - 3	3.69
4 - 6	5.29
7 - 9	3.49
10 - 12	1.68

When annual study year injury rates are calculated for each school level, it is found that trend for elementary schools is for injuries to be steadily increasing since 1987 (see Table 7). The rate for junior high students increased from 1987 to 1989, however, it decreased over the final two study years. Senior high injury rates showed a steady decline over the first three study years, but their rates increased in 1993. For special education students, their injury rates increased over the first three study years and then dropped by more than 50% in 1993.

Table 7

Average Annual Injury Rates by School Level

	Rates (per 100 student-years)		
Year	Elementary	Junior High	Senior High
1987	3.74	3.74	1.79
1989	4.18	3.82	1.67
1991	4.48	3.22	1.56
1993	4.74	2.90	1.67

When injury rates are standardized according to the distribution of students by grade in 1987 enrollments, these same trends are evidenced (see Table 8). Elementary students demonstrate an even greater increase in injury rates over time with the standardization. It should be noted that the injury rates in Table 7 appear slightly lower than would be expected based on the overall rates in Table 4. This is due to two causes: (a) special education students were selected out here into their own group whereas they are encompassed into their appropriate school level (elementary, junior and senior) in the overall rate calculations; and, (b) the numerator—number of injuries—is smaller because not all records had the date of injury completed and, thus were not included in this data run (resulting in 3778 total injuries for all grades). For the overall rate calculations, the researcher went through each record and noted the year of the injury; because records were entered into the computer in year blocks, it could very easily be determined what year the injury occurred for records where exact dates were not identified.

Table 8

Average Annual Injury Rates Standardized to 1987 Enrollments

	Rates (per 100 student-years)		
Year	Elementary	Junior High	Senior High
1987	3.74	3.74	1.79
1989	4.41	4.03	1.61
1991	5.46	3.68	1.49
1993	6.14	3.41	1.69

It should be noted that values for Special Education students have not been shown in the tables because of the instability of the rates associated with small numbers.

A total of 3277 of the total 3983 possible ARFs included the age of the injured student, for a completion rate of 82.3%. Corresponding to the grade levels, students aged 11 years had the highest number of ARFs with 434 (13.2%). Ten- and 9-year-olds followed with 369 (11.3%) and 337 (10.3%) ARFs, respectively (Table 8). Enrollment data on the age of students within the ECSB was unavailable, thus, injury rates for age groups could not be calculated. For 11- and 12-year-olds, the injury incidents were almost equal for males and females; 11-year-old males comprised 51.8% of the completed ARFs, while 12-year-old males made up 51.9% of the injuries (see Table 9).

Table 9

Age of Injured Students by Gender

	Gender					
	Female		Male		Total	
Age	No.	(% of age total)	No.	(% of age total)	No.	(% of age total)
4	2	(20.0)	8	(80.0)	10	(0.3)
5	59	(39.9)	89	(60.1)	148	(4.5)
6	97	(35.5)	176	(64.5)	273	(8.3)
7	127	(42.8)	170	(57.2)	297	(9.1)
8	131	(44.7)	162	(55.3)	293	(8.9)

(table continues)

	Gender					
	Female		Male		Total	
Age	No.	(% of age total)	No.	(% of age total)	No.	(% of age total)
9	147	(43.6)	190	(56.4)	337	(10.3)
10	161	(43.6)	208	(56.4)	369	(11.3)
11	209	(48.2)	225	(51.8)	434	(13.2)
12	137	(48.1)	148	(51.9)	285	(8.7)
13	91	(44.4)	114	(55.6)	205	(6.3)
14	106	(44.0)	135	(56.0)	241	(7.4)
15	70	(43.8)	90	(56.2)	160	(4.9)
16	45	(42.9)	60	(57.1)	105	(3.2)
17	25	(32.9)	51	(67.1)	76	(2.3)
18	3	(10.0)	27	(90.0)	30	(0.9)
≥19*	4	(28.6)	10	(71.4)	14	(0.3)
Total	1414	(43.1)	1863	(56.9)	3277	

*These students are all at a high school with a variety of special education programs. The Accident Report Forms were reviewed to ensure age is correct.

There were 3976 ARFs which identified the gender of the injured student; of these, females comprised 1682 (42.3%) and males 2294 (57.7%). Since data was not available on the overall male-to-female population ratio over the study period, gender frequencies are unavailable. If the assumption is made that the ratio of males to females is approximately equal, male students would be sustaining a greater number of injuries than their female

counterparts. There were four grades where the number of reported ARFs for males and females were approximately equal: Grade 3 (males 51.8%), Grade 6 (males 53.0%), Grade 7 (males 49.7%) and Grade 10 (males 50.8%). Grades 11 and 12 exhibited a much higher percentage of males with reported injuries than females, with rates of 68.4% and 78.7%, respectively (see Table 10).

Table 10

Grade of Injured Students by Gender

	Gender					
	Female		Male		Total	
Grade	No.	(% of total grade)	No.	(% of total grade)	No.	(% of total grade)
Kindergarten	66	(39.5)	101	(60.5)	167	(4.4)
1	149	(37.8)	245	(62.2)	394	(10.4)
2	111	(37.6)	184	(62.4)	295	(7.8)
3	183	(48.2)	197	(51.8)	380	(10.0)
4	165	(42.0)	228	(58.0)	393	(10.4)
5	190	(42.3)	259	(57.7)	449	(11.9)
6	222	(47.0)	250	(53.0)	472	(12.5)
7	154	(50.3)	152	(49.7)	306	(8.1)
8	100	(43.9)	128	(56.1)	228	(6.0)
9	124	(42.5)	168	(57.5)	292	(7.7)
10	95	(49.2)	98	(50.8)	193	(5.1)
11	42	(31.6)	91	(68.4)	133	(3.5)
12	17	(21.3)	63	(78.7)	80	(2.1)
Total	1618	(42.8)	2164	(57.2)	3782	

A total of 3549 ARFs had the time of injury recorded, for a completion rate of 89.1%. The program phase identifies what the student was participating in when the injury occurred; 3916 ARFs reported the program phase at the time of injury for a completion rate of 98.3%. The time period between 12:00 and 12:59 resulted in 1037 (29.2%) of all injuries); thus, over 1/4 of the injuries occurred over the noon hour (see Table 11). When this time period is cross-tabulated with the program phase at the time of injury, 851 (82.6%) of the injuries were identified as occurring "before/after school/noon hour play". Given the time of the injuries, it can be assumed that the large majority of the 851 injuries would correspond to noon hour play; however, the manner in which the Accident Report Forms collect this data makes it impossible to give an exact figure. For example, some kindergarten students start class at 1:00 p.m.; thus, being injured at 12:55 for one of these students would correspond to 'before school' while the time of injury points to the noon hour.

The two time periods demonstrating the next highest number of injuries were between 2:00 to 2:59 p.m., with 661 ARFs (18.6%), and 10:00 to 10:59 a.m., with 620 ARFs (17.5%). During both of these time intervals, the recess break accounted for the largest number of injuries. There were 337 injuries (52.4%) reported between 2:00 to 2:29 p.m. corresponding to the afternoon recess; 356 injuries (58.8%) occurred during the morning recess.

Table 11

Time of Day When Injuries Occurred

Time Periods	Number of Injuries	%
7:00 - 7:59 a.m.	3	0.1
8:00 - 8:59	149	4.2
9:00 - 9:59	184	5.2
10:00 - 10:59	620	17.5
11:00 - 11:59	312	8.8
12:00 - 12:59 p.m.	1037	29.2
1:00 - 1:59	388	10.9
2:00 - 2:59	661	18.6
3:00 - 3:59	123	3.5
after 4:00	72	2.0
Total	3549	100.0

For elementary school students, the before/after school/noon hour play and recess phases together accounted for almost 70% of all injuries, their totals being 945 (35.6%) and 889 (33.5%), respectively (see Table 12). As elementary students get older (i.e., Grades 4 to 6 versus K to 3), injuries during physical education instruction and while on field trips increase; additionally, females account for a higher proportion of these injuries than males. Junior and senior high students were most frequently injured during physical education instruction (see Table 13). Females in junior high accounted for 52.4% of the P.E. injuries while their senior high

counterparts had only 37.6%. For special needs students, 68% of their injuries occurred during the before/after school/noon hour (49.1%) and recess (19.3%) phases.

Table 12

Program Phase When Injuries Occurred by Grade Groups and Gender: Elementary Students

Program Phase	Grade Groups													
	K-3						4-6						Total Elementary	
	Females		Males		Total K-3		Females		Males		Total 4-6			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Before/After School, Noon Hour	195	(35.3)	303	(38.0)	498	(36.9)	164	(28.6)	283	(38.8)	447	(34.3)	945	(35.6)
Class/Lab	49	(8.9)	53	(6.6)	102	(7.5)	23	(4.0)	36	(4.9)	59	(4.5)	161	(6.1)
Field Trip	37	(6.7)	31	(3.9)	68	5.0)	61	(10.6)	48	(6.6)	109	(8.4)	177	(6.7)
Game/Practice	1	(0.2)	2	(0.3)	3	(0.2)	4	(0.7)	3	(0.4)	7	(0.5)	10	(0.4)
Intramurals	3	(0.5)	5	(0.6)	8	(0.6)	7	(1.2)	11	(1.5)	18	(1.4)	26	(1.0)
P. E. Class	70	(12.7)	105	(13.2)	175	(13.0)	129	(22.5)	118	(16.2)	247	(19.0)	422	(15.9)
Recess	191	(34.5)	293	(36.7)	484	(35.8)	179	(31.2)	226	(31.0)	405	(31.1)	889	(33.5)
Other	7	(1.3)	6	(0.8)	13	(1.0)	6	(1.1)	4	(0.5)	10	(0.8)	23	(0.9)
Totals	553		798		1351		573		729		1302		2653	

Note. K = Kindergarten. F = Females. M = Males. P.E. = Physical Education.

Table 13

Program Phase When Injuries Occurred by Grade Groups and Gender: Junior and Senior High Students

Program Phase	Grade Groups													
	7-9						10-12						Total Junior & Senior	
	Females		Males		Total 7-9		Females		Males		Total 10-12			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Before/After School, Noon Hour	80	(21.2)	148	(33.4)	228	(27.8)	28	(19.2)	31	(12.9)	59	(15.2)	287	(23.8)
Class/Lab	53	(14.0)	66	(14.9)	119	(14.5)	28	(19.2)	82	(34.0)	110	(28.4)	229	(19.0)
Field Trip	30	(7.9)	26	(5.9)	56	(6.8)	8	(5.5)	7	(2.9)	15	(3.9)	71	(5.9)
Game/Practice	27	(7.1)	27	(6.1)	54	(6.6)	19	(13.0)	15	(6.2)	34	(8.8)	88	(7.3)
Intramurals	9	(2.4)	14	(3.2)	23	(2.8)	3	(2.1)	12	(5.0)	15	(3.9)	38	(3.1)
P. E. Class	162	(42.9)	147	(33.2)	309	(37.6)	50	(34.2)	83	(34.4)	133	(34.4)	442	(36.6)
Recess	4	(1.1)	5	(1.1)	9	(1.1)	2	(1.4)	0		2	(0.5)	11	(0.9)
Other	13	(3.4)	10	(2.3)	23	(2.8)	8	(5.5)	11	(4.6)	19	(4.9)	42	(3.5)
Totals	378		443		821		146		241		387		1208	

Note. F = Females. M = Males. P. E. = Physical Education.

Circumstances of School Injuries

Facility Area

The facility area identifies the geographical location where the student was injured. A total of 3961 ARFs identified the facility area where the injury incident occurred, for a completion rate of 99.5%. A review of facility areas identified under "other" showed that the majority of these relate to field trip locations, examples of which include a bank, ranch, dairy, bowling alley and theater.

Students in Kindergarten to Grade 6 had 2685 ARFs which identified the facility area where their injury occurred. The playing field/tarmac was the leading site with 1092 records (40.7%), followed by the playground (513; 19.1%) and the gymnasium (405; 15.1%) (see Table 14). When the facility area and activity at the time of injury are cross-tabulated, 54.3% of the injuries to elementary students occurred on the playing field/tarmac during their free play time; 38.3% of the injuries occurred in the playground during free play. The Accident Report Form does not define the difference between "tarmac" and "playground", thus, it is likely that reporting inconsistency may exist in these classifications. Students in Kindergarten to Grade 3 incurred almost twice as many injuries on the playground as those in Grades 4 to 6 (24.6% versus 13.4%); elementary school males accounted for approximately 60% of all injuries in both the playground and playing field/tarmac (Table 14). Males and females in Grades 4 to 6 incurred approximately equal proportions of gymnasium and playground injuries, the second and third most common locations for injuries to occur. While only 4.2% of the injuries

Table 14

Facility Area (Location) Where Injury Occurred by Grade Groups and Gender: Elementary Students

Facility Area	Grade Groups													
	K-3						4-6						Total Elementary	
	Females		Males		Total K-3		Females		Males		Total 4-6			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Gymnasium	71	(12.8)	92	(11.3)	163	(11.9)	123	(21.3)	119	(16.2)	242	(18.5)	405	(15.1)
Playing Field/Tarmac	193	(34.7)	312	(38.2)	505	(36.8)	255	(44.2)	362	(49.3)	587	(44.8)	1092	(40.7)
Class/Lab	42	(7.6)	55	(6.7)	97	(7.1)	18	(3.1)	40	(5.4)	58	(4.4)	155	(5.8)
Playground	132	(23.7)	205	(25.1)	337	(24.6)	89	(15.4)	87	(11.9)	176	(13.4)	513	(19.1)
Hall/Stair	51	(9.2)	67	(8.2)	118	(8.6)	37	(6.4)	47	(6.4)	84	(6.4)	202	(7.5)
Pool	4	(0.7)	2	(0.2)	6	(0.4)	0		7	(1.0)	7	(0.5)	13	(0.5)
Rink	13	(2.3)	13	(1.6)	26	(1.9)	9	(1.6)	10	(1.4)	19	(1.4)	45	(1.7)
Locker Room	8	(1.4)	4	(0.5)	12	(0.9)	3	(0.5)	1	(0.1)	4	(0.3)	16	(0.6)
In Transit to/from School	5	(0.9)	10	(1.2)	15	(1.1)	4	(0.7))	3	(0.4)	7	(0.5)	22	(0.8)
In Transit to/from Field Trip	2	(0.4)	4	(0.5)	6	(0.4)	2	(0.3)	3	(0.4)	5	(0.4)	11	(0.4)
Cafeteria	1	(0.2)	5	(0.6)	6	(0.4)	0		3	(0.4)	3	(0.2)	9	(0.3)

(table continues)

Facility Area	Grade Groups												Total Elementary	
	K-3						4-6							
	Females		Males		Total K-3		Females		Males		Total 4-6			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Ski Hill	2	(0.4)	3	(0.4)	5	(0.4)	32	(5.5)	23	(3.1)	55	(4.2)	60	(2.2)
Park (Field Trip)	12	(2.2)	13	(1.6)	25	(1.8)	12	(2.1)	11	(1.5)	23	(1.8)	48	(1.8)
Bike Trail	0		0		0		9	(1.6)	1	(0.1)	10	(0.8)	10	(0.4)
Schoolgrounds	16	(2.9)	28	(3.4)	44	(3.2)	13	(2.3)	15	(2.0)	28	(2.1)	72	(2.7)
Other	4	(0.7)	3	(0.4)	7	(0.5)	1	(0.2)	2	(0.3)	3	(0.2)	10	(0.4)
Total	556		816		1372		577		734		1311		2683	

Note. K = Kindergarten. F = Females. M = Males.

to students in Grades 4 to 6 happened on the ski hill, 58.2% of these were sustained by females.

Junior high students had 823 records identifying the facility area where they were injured. The gymnasium, with 333 injury incidents (40.5%), was the location with the highest number of injuries; approximately equal proportions of males and females were injured in the gym (see Table 15). The second most frequent location was the playing field/tarmac with 165 injuries (20.0%). For junior high students, the location where the fifth highest number of injuries occurred was the ski hill with 28 cases (3.4%); 16 of these injuries were to females. Like their junior high counterparts, senior high students were injured most in the gymnasium, which accounted for 122 of their 400 ARFs (30.5%); this was followed by the classroom/lab/library with 93 (23.3%) (Table 15). The skating rink was the fifth leading site with 26 injuries (6.5%).

There were 53 ARFs identifying the facility area where special education students were injured. The most common injury location was the playing field/tarmac with 16 incidents (30.2%), followed by the classroom/lab/library and playground with 9 cases (15.8%) each.

The off-school site which resulted in the highest total number of injuries was the ski hill with 98 (2.5%); this was followed by the skating rink with 77 (1.9%).

Table 15

Facility Area (Location) Where Injury Occurred by Grade Groups and Gender: Junior and Senior High Students

Facility Area	Grade Groups													
	7-9						10-12						Total Junior & Senior	
	Females		Males		Total 7-9		Females		Males		Total 10-12			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Gymnasium	173	(45.9)	160	(35.9)	333	(40.5)	56	(37.1)	66	(26.5)	122	(30.5)	455	(37.2)
Playing Field/Tarmac	61	(16.2)	104	(23.3)	165	(20.0)	26	(17.2)	43	(17.2)	69	(17.3)	234	(19.1)
Class/Lab	38	(10.1)	54	(12.1)	92	(11.2)	24	(15.9)	69	(27.7)	93	(23.3)	185	(15.1)
Playground	3	(0.8)	10	(2.2)	13	(1.6)	0		0		0		13	(1.1)
Hall/Stair	36	(9.5)	52	(11.7)	88	(10.7)	21	(13.9)	30	(12.0)	51	(12.8)	139	(11.4)
Pool	4	(1.1)	3	(0.7)	7	(0.9)	1	(0.7)	2	(0.8)	3	(0.8)	10	(0.8)
Rink	2	(0.5)	3	(0.7)	5	(0.6)	8	(5.3)	18	(7.2)	26	(6.5)	31	(2.5)
Locker Room	9	(2.4)	9	(2.0)	18	(2.2)	3	(2.0)	2	(0.8)	5	(1.3)	23	(1.9)
In Transit to/from School	4	(1.1)	8	(1.8)	12	(1.5)	1	(0.7)	0		1	(0.3)	13	(1.1)
In Transit to/from Field Trip	0		1	(0.2)	1	(0.1)	0		0		0		1	(0.1)
Cafeteria	5	(1.3)	3	(0.7)	8	(1.0)	1	(0.7)	5	(2.0)	6	(1.5)	14	(1.1)

(table continues)

Facility Area	Grade Groups													
	7-9						10-12						Total Junior & Senior	
	Females		Males		Total 7-9		Females		Males		Total 10-12			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Ski Hill	16	(4.2)	12	(2.7)	28	(3.4)	4	(2.6)	2	(0.8)	6	(1.5)	34	(2.8)
Park (Field Trip)	5	(1.3)	7	(1.6)	12	(1.5)	2	(1.3)	2	(0.8)	4	(1.0)	16	(1.3)
Bike Trail	4	(1.1)	6	(1.3)	10	(1.2)	1	(0.7)	3	(1.2)	4	(1.0)	14	(1.1)
Schoolgrounds	12	(3.2)	12	(2.7)	24	(2.9)	2	(1.3)	3	(0.8)	5	(1.3)	29	(2.4)
Other	5	(1.3)	2	(0.4)	7	(0.9)	1	(0.7)	4	(1.6)	5	(1.3)	12	(1.0)
Total	377		446		823		151		249		400		1223	

Note. F = Females. M = Males.

Activity at the Time of Injury

There were 3249 ARFs which identified the activity that the student was participating in at the time of their injury; this represents 81.6% of the ARFs. One wouldn't expect the entire number of forms to have this category completed, since all children are unlikely to be injured during a specific (athletic or related) activity. The data showed that over one-third (1224; 37.7%) of all students whose ARF identified an activity were injured during free play/spontaneous activity (see Table 16).

Table 16

Activity at Time of Injury by School Level

	School Level							
	Elementary		Junior High		Senior High		Total	
Activity	No.	%	No.	%	No.	%	No.	%
Aquatics	11	(0.5)	7	(1.1)	4	(1.2)	23	(0.7)
Basketball	43	(1.9)	91	(13.8)	26	(8.1)	160	(4.9)
Cycling	15	(0.7)	11	(1.7)	3	(0.9)	29	(0.9)
Dodgeball	38	(1.7)	8	(1.2)	1	(0.3)	48	(1.5)
Floor Hockey	51	(2.3)	34	(5.2)	4	(1.2)	89	(2.7)
Football (tackle)	8	(0.4)	10	(1.5)	12	(3.7)	30	(0.9)
Football (flag, touch)	38	(1.7)	31	(4.7)	12	(3.7)	81	(2.5)
Free Play	1179	(52.8)	57	(8.7)	8	(2.5)	1224	(37.7)
Games Lesson	46	(2.1)	5	(0.8)	0		51	(1.6)
Gymnastics (apparatus)	72	(3.2)	20	(3.0)	8	(2.5)	101	(3.1)
Gymnastics (free exercise)	22	(1.0)	14	(2.1)	1	(0.3)	37	(1.1)
Ice Hockey	3	(0.1)	2	(0.3)	15	(4.7)	20	(0.6)

(table continues)

	School Level							
	Elementary		Junior High		Senior High		Total	
Activity	No.	%	No.	%	No.	%	No.	%
Ice Sports (other)	37	(1.7)	4	(0.6)	11	(3.4)	53	(1.6)
Organized Play	41	(1.8)	0		1	(0.3)	43	(1.3)
Regular Class	94	(4.2)	76	(11.6)	82	(25.5)	254	(7.8)
Skiing	63	(2.8)	29	(4.4)	4	(1.2)	101	(3.1)
Snow Activities	35	(1.6)	5	(0.8)	4	(1.2)	44	(1.4)
Soccer/Speedball	174	(7.8)	62	(9.4)	44	(13.7)	281	(8.6)
Softball/Baseball	60	(2.7)	11	(1.7)	6	(1.9)	77	(2.4)
Track & Field	13	(0.6)	38	(5.8)	6	(1.9)	57	(1.8)
Volleyball	20	(0.9)	67	(10.2)	21	(6.5)	108	(3.3)
Walking	74	(3.3)	21	(3.2)	2	(0.6)	97	(3.0)
Other	59	(2.6)	55	(8.4)	25	(7.8)	141	(4.3)
Total	2232		658		321		3249	

Note. Totals include injuries to Special Education students not shown in this Table. P.E. = Physical Education.

The second leading activity was soccer/speedball with 281 injuries (8.6%). Regular class instruction was identified in 254 (7.8%) of the cases. The number here is lower than what appears for this classification in the program phase component of the study, likely due to the fact that "regular class instruction" was not specifically identified in the activity section of the ARF (being added as a category for coding after the pilot study). When free play and regular class instruction are not included in the activity analysis, the top three specific athletic activities resulting in injury are

soccer/speedball, basketball and non-physical-education related running (see Table 17).

Table 17

Five Most Common Athletic Activities Resulting in Injury for Each School Level

Overall		Elementary[a]		Junior[b]		Senior[c]	
Activity	%	Activity	%	Activity	%	Activity	%
Soccer	(16.2)	Soccer	(18.1)	Basketball	(17.3)	Soccer	(19.0)
Basketball	(9.2)	Walking	(7.7)	Volleyball	(12.8)	Basketball	(11.3)
Volleyball	(6.2)	Gymnastics (apparatus)	(7.5)	Soccer	(11.8)	Volleyball	(9.1)
Skiing	(5.8)	Skiing	(6.6)	Track & field	(7.2)	Ice Hockey	(6.5)
Gymnastics (apparatus)	(5.8)	Softball/ Baseball	(6.3)	Floor Hockey	(6.5)	Football (tackle & flag/touch)	(5.2)

Note. Free play and regular class instruction not included.

[a]n = 959 Accident Report Forms. [b]n = 525 Accident Report Forms. [c]n = 231 Accident Report Forms.

There were 2232 ARFs which identified the activity during which elementary students were injured. Free play/spontaneous activity accounted for 1179 (52.8%) injuries. Soccer/speedball were the distant second leading activities with 174 injuries (7.8%), and non-physical-education running accounted for 112 injuries (5.0%) (Table 16). If the number of injuries resulting from free play and regular class instruction are subtracted from the total number of ARFs identifying an activity, 959 specific sport activities

remain. With this new total, the five activities leading to the greatest number of injuries are: soccer/speedball, walking, gymnastics apparatus, skiing, and softball/baseball (Table 17).

Junior high students had 658 ARFs which identified the activity at the time of injury. Basketball was the leading activity with a total of 91 injuries (13.8%) which were spread evenly between males and females. This was followed by regular class instruction with 76 (11.6%) and volleyball with 67 injury events (10.2%) (Table 15). Sixty-six percent of the volleyball injuries were sustained by females. When free play and regular class instruction were removed from the total, 525 ARFs identifying sport activities remained. The sports resulting in the highest number of injuries for junior high students were basketball, volleyball, soccer, and track and field/cross-country (Table 17).

Students in Grades 10 to 12 had 321 ARFs reporting the activity at the time of injury. Regular class instruction had the highest number of injuries with 82 (25.5%), followed by soccer with 44 (13.7%) and basketball with 26 (8.1%) injuries. When regular class instruction and free play were removed from the list, a total of 231 ARFs remained. The leading sport activities resulting in injuries to senior high students were soccer, basketball, volleyball, and ice hockey (Table 17). Like their counterparts in junior high, senior high females sustained the majority of the volleyball injuries (71.4%).

There were 38 ARFs which identified an activity at the time of injury for special education students. Free play was the leading activity with 19 injuries (50.0%), followed by skiing with 5 cases (13.2%).

Probable Direct Cause of the Injury

There were 3948 (99.1%) ARFs where the probable direct cause of the injury could be established. Table 18 identifies the leading causes of injury for each of the grade groups. There are distinct commonalities among all the grade groups, namely accidental collisions, blows delivered by an object and falls not due to external factors. A fall or loss of balance due to apparatus or equipment was a more prevalent cause among elementary and special education students, whereas carelessness on the part of the student occurred more at the junior and senior school levels. Not surprisingly, given the younger elementary students' higher rate of injuries on the playground, students in Kindergarten to Grade 3 sustained approximately 40% more injuries from falls or loss of balance from apparatus/equipment than did the older elementary students.

Over all school levels, the four most common causes of injuries for males and females were the same; however, as Table 19 indicates, they occurred in a slightly different order. For females, the leading cause was a blow delivered by an object, while for males the main cause was an accidental collision between participants. Due to the fact that males demonstrated higher injury proportions overall, for almost all the probable causes of the injury males had a higher number. However, there were two causes which were more often associated with females: (a) strain or overexertion, and (b) jump/improper landing from equipment/apparatus.

Table 18

Probable Direct Cause of Injury by Grade Groups

Cause	Grade Group									
	K-3		4-6		7-9		10-12		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Accidental collision between participants	237	(17.4)	237	(18.1)	120	(14.6)	46	(11.4)	640	(16.4)
Blow delivered by an object (ball, bat, etc.)	159	(11.6)	235	(18.0)	155	(18.9)	76	(18.9)	625	(16.0)
Body contact (not considered a collision) in the normal course of an activity	65	(4.8)	79	(6.0)	60	(7.3)	38	(9.5)	242	(6.2)
Carelessness on part of pupil	81	(5.9)	59	(4.5)	79	(9.6)	46	(11.4)	265	(6.8)
Fall/trip not due to an observed external factor	181	(13.3)	190	(14.5)	132	(16.1)	38	(9.5)	541	(13.9)
Fall or loss of balance where apparatus/equipment concerned	227	(16.6)	125	(9.6)	56	(6.8)	27	(6.7)	435	(11.2)
Fall/slip due to ice/snow on schoolground (playground, sidewalk, etc.)	135	(9.9)	95	(7.3)	12	(1.5)	0		242	(6.2)
Aggressive behavior/fight	73	(5.3)	89	(6.8)	40	(4.9)	9	(2.2)	211	(5.4)
Accidental collision between student and object (e.g., wall, pole, etc.)	74	(5.4)	63	(4.8)	28	(3.4)	15	(3.7)	180	(4.6)
Other	133	(9.7)	135	(10.2)	139	(16.9)	107	(26.6)	514	(13.2)
Total	1365		1307		821		402		3895	

Note. K = Kindergarten. Totals do not include injuries to Special Education students.

Table 19

Probable Direct Cause of Injury by Gender: Six Leading Causes

Females		
Cause	No.	%
Blow delivered by an object (ball, bat, etc.)	290	17.4
Fall/trip not due to an observed external factor	268	16.0
Accidental collision between participants	258	15.4
Fall or loss of balance where apparatus/equipment concerned	212	12.7
Fall/slip due to ice/snow on schoolground (playground, sidewalk, etc.)	102	6.1
Carelessness on part of pupil	99	5.9

Males		
Cause	No.	%
Accidental collision between participants	390	17.2
Blow delivered by an object (ball, bat, etc.)	339	14.9
Fall/trip not due to an observed external factor	280	12.3
Fall or loss of balance where apparatus/equipment concerned	230	10.1
Carelessness on part of pupil	168	7.4
Body contact (not considered a collision) in the normal course of an activity	153	6.7

Nature of the Injuries

Anatomical Distribution

A total of 3965 ARFs identified the body region(s) harmed during the injury incident; this corresponds to a completion rate of 99.6%. The 3965 ARFs identified a total of 4573 body regions, due to the fact that more than one body region may have been injured per incident and up to three were entered into the database; if more than three body regions were identified, the first three were entered.

The data showed that the vast majority of injury incidents—3426 of the 3965 ARFs (86.4%)—resulted in one body region being harmed (see Table 20). There were 19 (0.5%) injury incidents where no body regions were injured, which could result from events such as fainting or seizures. There were only four records that utilized the "other" category; of these, two identified the hip, one indicated a choking incident, and one said that the student struck a wall.

Table 20

Number of Body Regions Injured per Injury Incident by Grade Groups

	Grade Groups											
	K-3		4-6		Total Elementary		7-9		10-12		Total Junior & Senior High	
No. of Regions	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0	3	(0.2)	2	(0.2)	5	(0.2)	6	(0.7)	6	(1.5)	19	(0.5)
1	1177	(85.8)	1147	(87.4)	2324	(86.6)	715	(86.8)	344	(84.9)	3426	(86.4)
2	164	(12.0)	132	(10.0)	296	(11.0)	85	(10.3)	44	(10.9)	431	(10.9)
3	19	(1.4)	26	(2.0)	45	(1.7)	16	(1.9)	7	(1.7)	70	(1.8)
4	7	(0.5)	3	(0.2)	10	(0.4)	1	(0.1)	4	(1.0)	15	(0.4)
5	1	(0.1)	2	(0.2)	3	(0.1)	1	(0.1)	0		4	(0.1)
Total No. ARFs	1371		1312		2683		824		405		3965	
Total No. Regions Injured	1589		1506		3095		944		471		4573	

Note. K = Kindergarten. ARFs = Accident Report Forms. Totals include injuries to Special Education students.

When the specific body regions were analyzed, it was found that injuries to the head were most prevalent with 902 (19.7%) cases (see Table 21). The face was the second most frequently injured region with 551 (12.1%). When the head and face categories are combined, they account for 31.8% of all injured body regions. Injuries to the fingers were reported on 401 ARFs for a rate of 8.8%; when finger and hand (178) injuries are combined, their total accounts for 12.7% of all injured regions.

Table 21

Specific Body Regions Injured Over All Grade Levels

	Total No. of Injuries	
Region	No.	%
Head	902	(19.7)
Face	551	(12.1)
Finger	401	(8.8)
Ankle	268	(5.8)
Knee	278	(6.1)
Wrist	235	(5.1)
Teeth	257	(5.6)
Other	1681	(36.8)
Total	4573	

There were 2683 ARFs which identified 3095 injured body regions in elementary school students. In terms of total body regions injured per incident, 2324 (86.6%) of the ARFs reported one injured area. The head, with 732 incidents (23.7%), and face, with 447 (14.4%), were the most commonly injured body regions. Their combined total of 1179 injuries gives a rate of 38.1%; in other words, over one third of all injuries to elementary school students were to the head and face area. For both males and females, elementary students in Kindergarten to Grade 3 experienced more head and face injuries than those in Grades 4 to 6 (see Table 22).

There were 824 ARFs identifying 944 injured body regions among students in Grades 7 to 9. With respect to the total number of body regions harmed per incident, 715 of the ARFs reported only one injured region for a rate of 86.8%. For junior high students, the finger was the most frequently injured body part with a total of 125 incidents (13.2%); males and females sustained finger injuries in equal proportions (see Table 23). Ankles had the second highest number of injuries at 108 (11.4%) and ankle injuries were more prevalent among females. The head had 106 reported injuries (11.2%); once again, when injuries to the head and face are added together, their combined total of 169 cases, for a rate of 17.9%, would put them at the top of the list of body regions injured. However, injuries to the head and face are more common among males at this age group (21.9%) than females (13.3%).

Table 22

Specific Body Regions Injured by Grade Groups and Gender: Elementary Students

Body Region	Grade Groups													
	K-3						4-6						Total Elementary	
	Females		Males		Total K-3		Females		Males		Total 4-6			
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Head	169	(26.3)	282	(29.8)	451	(28.4)	108	(15.4)	172	(20.5)	280	(19.4)	731	(24.1)
Face	107	(16.6)	168	(17.8)	275	(17.3)	63	(9.4)	109	(13.0)	172	(11.9)	447	(14.7)
Finger	32	(5.0)	42	(4.4)	74	(4.7)	73	(10.9)	57	(6.8)	130	(9.0)	204	(6.7)
Ankle	25	(3.9)	19	(2.0)	44	(2.8)	45	(7.4)	25	(3.0)	70	(4.8)	114	(3.8)
Knee	30	(4.7)	31	(3.3)	61	(3.8)	51	(7.6)	59	(7.0)	110	(7.6)	171	(5.6)
Wrist	44	(6.8)	31	(3.3)	75	(4.7)	50	(7.5)	42	(5.0)	92	(6.4)	167	(5.5)
Teeth	42	(6.5)	77	(8.1)	119	(7.5)	32	(5.5)	64	(7.6)	96	(6.7)	215	(7.1)
Other	194	(30.2)	295	(31.2)	489	(30.8)	187	(30.7)	309	(36.9)	496	(34.3)	985	(32.5)
Total	643		945		1588		609		837		1446		3034	

Note. K = Kindergarten. F = Females. M = Males.

Table 23

Specific Body Regions Injured by Grade Groups and Gender: Junior and Senior High Students

Facility Area	Grade Groups											
	7-9						10-12					
	Females		Males		Total 7-9		Females		Males		Total 10-12	
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total
Head	37	(8.5)	69	(13.6)	106	(11.2)	28	(15.3)	28	(9.7)	56	(11.9)
Face	21	(4.8)	42	(8.3)	63	(6.7)	9	(4.9)	22	(7.6)	31	(6.6)
Finger	59	(13.5)	66	(13.0)	125	(13.2)	27	(14.8)	42	(14.6)	69	(14.6)
Ankle	63	(14.4)	45	(8.9)	108	(11.4)	21	(11.5)	20	(6.9)	41	(8.7)
Knee	37	(8.5)	31	(6.1)	68	(7.2)	15	(8.2)	19	(6.6)	34	(7.2)
Wrist	20	(4.6)	25	(4.9)	45	(4.8)	10	(5.5)	13	(4.5)	23	(4.9)
Teeth	8	(1.8)	16	(3.1)	24	(2.5)	3	(1.6)	9	(3.1)	12	(2.5)
Other	191	(43.8)	214	(42.1)	405	(42.9)	70	(38.3)	135	(46.9)	205	(43.5)
Total	436		508		944		183		288		471	

Note. F = Females. M = Males.

Students in Grades 10 to 12 had 405 ARFs identifying 471 injured body regions. Consistent with the other grade levels, the majority of injury incidents results in only one body part being injured: 344 of the cases for a frequency of 84.9%. There were six injury events (1.5%) which reported no body regions being injured, which would occur with an incident such as a drug overdose. In terms of the specific body regions injured, like their junior high counterparts, those in senior high injured their fingers most often: 69 times for a frequency of 14.7%. Finger injuries occurred in equal proportions for males and females. The head accounted for 56 (11.9%) of the injured regions with females sustaining one third more head injuries, on a proportionate basis, than males. The eyes were injured 44 times (9.3%), however, the proportion of eye injuries in males was over twice that of females. The ankle and knee were the next most frequently injured areas, with totals of 34 (7.2%) and 33 (7.0%), respectively. When injuries to the head and face were combined, their total of 87 (18.5%) would, once again, make them the most commonly injured region overall, and for both males and females, in this age group.

Special Education students had 53 ARFs where body regions were identified for the injury event; these ARFs reported 63 injured regions. In terms of total body parts injured per incident, one injured region accounted for 43 of the events (80.1%). The most frequently injured body part was the face, accounting for 10 (15.9%) of the injured regions; the head followed closely with 8 (12.7%). The combined face and head total of 18 gives a frequency of 28.6%.

Diagnostic Pattern

A total of 3904 ARFs identified the type of injury incurred by the student, for a completion rate of 98.0%. Up to three injury types per injury incident could be entered into the database, thus, a total of 4316 injury types were reported. If more than three injuries were identified on the ARF, the three most serious (as determined by the researcher) were recorded; there were only three ARFs identifying more than three injuries. The very large majority of the ARFs, a total of 3528 of the possible 3904 (90.4%), reported one type of injury per incident.

In terms of the specific injury types that the students incurred, bruises (21.1%) and lacerations/incisions/punctures (16.9%) were the most common. These were followed by sprains (11.7%) and fractures (11.3%) (see Table 24).

Table 24

Five Leading Types of Injuries Overall by Gender

Injury	Female[a]		Male[b]		Total[c]	
	No.	% of females	No.	% of males	No.	%
Bruise	400	(22.0)	509	(20.4)	909	(21.1)
Laceration/Incision/Puncture	214	(11.8)	517	(20.7)	731	(16.9)
Sprain	294	(16.2)	210	(8.4)	504	(11.7)
Fracture	202	(11.1)	286	(11.5)	488	(11.3)
Abrasion	155	(8.5)	237	(9.5)	392	(9.1)

[a]n = 1818. [b]n = 2497. [c]n = 4315.

When the types of injuries were broken down by gender (see Tables 24 - 26), overall it was found that males and females across the grade levels had quite similar diagnostic patterns. The main differences were that sprains were much more prevalent in females (16.2% versus 8.4% for males), while lacerations/ incisions/punctures were more common in males (20.7% versus 11.8% in females). Fractures accounted for an equal proportion of the injuries in both males and females (11.5% versus 11.1%, respectively).

A review of the "other" category for type of injury included the following descriptions: bee stings, dog bites, poisoning, frostbite, drug overdose, and choking. Additionally, it identified probably the most serious injury encountered, a crushed spleen, which occurred when the student slid down a stairway bannister and fell on his abdomen.

Elementary school students had 2639 ARFs identifying 2920 types of injuries. The majority of injury incidents, a total of 2382 (90.3%), resulted in just one injury. Bruises were the most common injury type accounting for 678 cases (23.2%), followed by laceration/incisions/punctures with 507 (17.4%) and fractures and abrasions with 307 (10.5%) each. While fractures occurred in approximately equal proportions for males and females in both the younger (Kindergarten to Grade 3) and older (Grades 4 to 6) students, sprains were more prevalent in the older group, especially among females (Table 26).

Junior high students had 811 ARFs identifying 887 injury types. There were 741 ARFs (91.4%) which reported only one type of injury per incident. There were no ARFs which reported more than three injury types occurring in any one incident. For junior high students, the most frequent

Table 25

Five Leading Types of Injuries by Grade Groups and Gender: Elementary Students

Type of Injury	Grade Groups													
	K-3						4-6							
	Females[a]		Males[b]		Total K-3[c]		Females[d]		Males[e]		Total 4-6[f]		Total Elementary[g]	
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total	No.	% of total
Bruise	127	(20.7)	203	(22.7)	330	(21.9)	168	(27.1)	180	(22.7)	348	(24.6)	678	(23.2)
Laceration/Incision/ Puncture	96	(15.7)	207	(23.2)	303	(20.1)	65	(10.5)	139	(17.5)	204	(14.4)	507	(17.4)
Fracture	72	(11.7)	86	(9.6)	158	(10.5)	66	(10.7)	83	(10.5)	149	(10.5)	307	(10.5)
Abrasion	70	(11.4)	115	(12.9)	185	(12.3)	56	(9.0)	66	(8.3)	122	(8.6)	307	(10.5)
Sprain	43	(7.0)	32	(3.4)	75	(5.0)	115	(18.6)	68	(8.6)	183	(13.0)	258	

Note. K = Kindergarten. F = Females. M = Males.

[a]n = 613. [b]n = 893. [c]n = 1506. [d]n = 619. [e]n = 794. [f]n = 1413. [g]n = 2919.

Table 26

Five Leading Types of Injuries by Grade Groups and Gender: Junior and Senior High Students

Facility Area	Grade Groups											
	7-9						10-12					
	Females[a]		Males[b]		Total 7-9[c]		Females[d]		Males[e]		Total 10-12[f]	
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total
Bruise	77	(19.2)	91	(18.7)	163	(18.4)	24	(14.1)	24	(8.7)	48	(10.7)
Laceration/Incision/ Puncture	31	(7.7)	86	(17.7)	117	(13.2)	18	(10.6)	72	(26.0)	90	(20.1)
Fracture	45	(11.2)	77	(15.9)	122	(13.8)	17	(8.3)	34	(12.3)	51	(11.4)
Abrasion	20	(5.0)	36	(7.4)	56	(6.3)	7	(4.1)	19	(6.9)	26	(5.8)
Sprain	107	(26.6)	70	(14.4)	177	(20.0)	29	(17.1)	34	(12.3)	63	(14.1)

Note. F = Females. M = Males.

[a]n = 402. [b]n = 485. [c]n = 887. [d]n = 170. [e]n = 277. [f]n = 447.

injury type were sprains, accounting for 177 (20.0%) of the injuries; 26.6% of the injuries to junior high females were sprains, as compared to 14.4% for males. Bruises with 163 (18.4%) cases were the second leading injury type, followed by fractures with 122 (13.8%), and lacerations/incisions /punctures with 117 (13.2%) (Table 26).

Senior high students accounted for 401 ARFs which identified a total of 447 injury types. Similar to elementary and junior high students, those in senior high most frequently had just one type of injury per incident (360; 89.8%). Lacerations/incisions/punctures were the most common types of injuries occurring to senior high students, accounting for 90 (20.1%) of the injuries; senior high males sustained over twice as many of these types of injuries than females. Sprains were the second most frequent type of injury with 63 cases (14.1%), and fractures were third with 51 (11.4%) (Table 26). Concussion, considered a serious injury, was the fifth most common type of injury and males had a rate twice that of females.

A total of 53 ARFs were recorded for special education students, corresponding to 62 specific types of injuries. Bruises were the most common type of injury with 15 cases (24.2%), followed by laceration/incision/puncture with 10 (16.1%), and fractures with 8 (12.9%).

Serious versus Minor Injuries

Injury severity is a somewhat arbitrary classification scheme, since the definition of serious injury may vary depending on who is doing the classifying. To date, none of the school injury studies have had a consensus on what they consider to be serious and minor injuries. Using the

classification scheme for serious and minor injuries outlined in the "Methods" chapter of this text, it was found that serious injuries accounted for 39.0% of all injuries; this corresponds to a frequency of 1.52 serious injuries per 100 student-years. When serious and minor injuries are compared at the various grade levels, elementary students in Grades 4 to 6 were found to have the highest frequency of serious injuries at 2.14 injuries per 100 student-years (see Table 27).

Table 27

Proportion and Rate of Serious Injuries by Grade Group and Gender

	Grade Group							
	K - 3		4 - 6		7 - 9		10 - 12	
	Gender		Gender		Gender		Gender	
	F	M	F	M	F	M	F	M
No. of serious injuries	208	245	246	285	228	225	91	129
Proportion (%)	33.9	27.4	39.7	35.9	56.7	46.4	53.5	46.6
Total F and M	453		531		453		220	
Rate (per 100 student -years)	1.35		2.14		1.91		0.91	

Note. K = Kindergarten. F= Females. M = Males.

Thus, not only do students in Grades 4 to 6 have the highest rate of injury, they also have the highest rate of serious injury.

While junior and senior high students had lower rates of serious injuries (1.91 and 0.91 serious injuries per 100 student-years, respectively, they did sustain the highest proportions of serious injuries overall. It is interesting to note that females at all grade levels (except Grades 7 to 9) sustained fewer serious injuries, but sustained proportionately more serious injuries than their male counterparts (Table 27). This would infer that while males appear to be more prone to injuries in the school environment, when injuries to females occur, they are of a more serious nature. For both males and females, the proportion of serious injuries increased as the grade levels increased until junior high; senior and junior high levels were about the same.

Treatment of the Injured Student

Parent Notification

There were a total of 3845 Accident Report Forms which identified whether the parents were notified or not, for a completion rate of 96.5%. Overall, 3002 (78.1%) of the ARFs indicated that the parents had been informed, thus, in 843 (21.9%) of the cases the parents were not notified.

For elementary school students, 81.5% (2132 of 2615 ARFs) of the injury incidents resulted in the parents being notified, with the rate of parent notification decreasing as the grade levels increase (see Table 28).

Table 28

Parent Notification by School Level

	School Level							
	Elementary		Junior High		Senior High		Total	
Parent Notified	No.	%	No.	%	No.	%	No.	%
Yes	2132	(81.5)	609	(75.7)	219	(58.7)	3002	78.1
No	483	(18.5)	196	(24.3)	154	(41.3)	843	21.9
Total	2615		805		373		3845	

Note. Totals include Special Education level.

Transport to Hospital or Medicentre

There were 3590 ARFs which indicated whether or not the injured students had been taken to a hospital or medicentre/physician's office, of which 1957 (54.5%) indicated that they had been transported to one of these facilities. Elementary school students were the least likely to require transport to a medical facility, with a rate of 49.1% (see Table 29). In fact, the younger elementary students (Kindergarten to Grade 3), had the lowest rate of transport at 46.3%. Injuries to junior high school students necessitated transport to a medical facility 60.6% of the time (see Table 30). Senior high students had the highest frequency of transportation to a hospital or medicentre with a rate of 76.8% (Table 30). Special education students were transported to a medical facility 51.0% of the time. Both

males and females demonstrated an increasing tendency for medical transport with increasing grade levels.

Table 29

Transport to Hospital/Medicentre by Grade Group and Gender: Elementary Students

	Grade Group						
	K-3			4-6			
Transported to Hospital/ Medicentre	Female	Male	Total K-3	Female	Male	Total 4-6	Total Elementary
No.	240	333	573	255	348	603	1176
%	47.0	45.8	46.3	49.8	54.0	52.1	49.1

Note. K = Kindergarten.

Table 30

Transport to Hospital/Medicentre by Grade Group and Gender: Junior and Senior High Students

	Grade Group					
	7-9			10-12		
Transported to Hospital/ Medicentre	Female	Male	Total 7-9	Female	Male	Total 10-12
No.	208	251	459	108	188	296
%	60.8	60.3	60.6	72.5	79.7	76.9

Disposition

This category identified what happened to the student after the injury event; a total of 3972 ARFs comprised the analysis. Except for those students in Kindergarten to Grade 3 (who most often went back to class), for all grade levels, the most frequent disposition was attended to at school and then transported to a medicentre or physician's office (see Tables 31 and 32). When disposition was cross-tabulated with gender, it was found that, at each grade level, males and females reported approximately equal proportions for each of the four main dispositions (Tables 31 and 32). One of the largest differences is exhibited between males and females in senior high: males had a higher proportion of physician visits (39.3% versus 35.1%), whereas females went back to class more often (16.2% versus 10.3%). While physician/medicentre visits did not vary much between gender and grade levels, the frequency of hospital visits was shown to increase as grade levels increased.

Table 31

Disposition of the Injured Students by Grade Groups and Gender: Elementary Students

Disposition	Grade Groups											
	K-3						4-6					
	Females[a]		Males[b]		Total K-3[c]		Females[d]		Males[e]		Total 4-6[f]	
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total
Medicentre	159	(28.4)	240	(29.4)	399	(29.0)	189	(32.8)	258	(35.1)	447	(34.1)
Hospital	77	(13.8)	96	(11.8)	173	(12.6)	61	(10.6)	86	(11.7)	147	(11.2)
Home	79	(14.1)	106	(13.0)	185	(13.5)	85	(14.8)	94	(12.8)	179	(13.6)
Back to Class	189	(33.8)	273	(33.5)	462	(33.6)	159	(27.6)	202	(27.4)	361	(27.5)
Unknown	46	(8.2)	87	(10.7)	133	(9.7)	70	(2.2)	87	(11.8)	157	(12.0)
Other	9	(1.6)	14	(17.2)	23	(1.7)	12	(2.1)	9	(1.2)	21	(1.6)

Note. K = Kindergarten. F = Females. M = Males.

[a]n = 559. [b]n = 816. [c]n = 1375. [d]n = 576. [e]n = 736. [f]n = 1312.

Table 32

Disposition of the Injured Students by Grade Groups and Gender: Junior and Senior High Students

Disposition	Grade Groups											
	7-9						10-12					
	Females[a]		Males[b]		Total 7-9[c]		Females[d]		Males[e]		Total 10-12[f]	
	No.	% of F	No.	% of M	No.	% of total	No.	% of F	No.	% of M	No.	% of total
Medicentre	126	(33.3)	141	(31.6)	267	(32.4)	54	(35.1)	99	(39.3)	153	(37.7)
Hospital	78	(20.6)	104	(23.3)	182	(22.1)	53	(34.4)	85	(33.7)	138	(34.0)
Home	21	(5.6)	38	(8.5)	59	(7.2)	11	(7.1)	11	(4.4)	22	(5.4)
Back to Class	93	(24.6)	107	(24.0)	200	(24.3)	25	(16.2)	26	(10.3)	51	(12.6)
Unknown	48	(12.7)	40	(9.0)	88	(10.7)	10	(6.5)	21	(8.3)	31	(7.6)
Other	12	(3.2)	16	(3.6)	28	(3.4)	1	(0.7)	10	(4.0)	11	(2.7)

Note. F = Females. M = Males.

[a]n = 378. [b]n = 446. [c]n = 824. [d]n = 154. [e]n = 252. [f]n = 406.

Chapter 5

DISCUSSION

The incidence rate for the routine reporting of school-related injuries has varied widely across the previous retrospective studies, from a low of 1.67 to a high of 7.45 per 100 student-years. The retrospective study by Dale et al. (1969) was the first published research on school injuries and it recited an incidence rate of 7.45 injuries per 100 student-years (elementary students only); this is much higher than the two other retrospective studies with rates of 1.67 injuries per 100 student-years (Taketa, 1984) and 2.82 injuries per 100 student-years (Sheps & Evans, 1987). The three prospective studies (Boyce et al., 1984; Feldman et al., 1983; Lenaway et al., 1992) all reported higher injury rates than the retrospective research.

This retrospective study, analyzing injuries within Edmonton Catholic schools, has a calculated incidence of 4.11 injuries per 100 student-years. While this rate is lower than that of Dale et al. (1969), it is higher than the rates for the two other retrospective studies (Sheps & Evans, 1987; Taketa, 1984). However, in spite of this higher injury rate, under-reporting is still suspected, as there are no definitive guidelines for the reporting of school injuries within the Edmonton Catholic School Board. This idea is also supported by the higher reported school injury rates for the prospective studies. Further evidence for the notion of under-reporting lies with the findings from the McMaster studies which showed much higher incidence rates under an "all-report" system and through interviews with parents (Hodgson et al., 1985; Woodward et al., 1984). The "all-report" study

consisted of targeting 50 randomly chosen schools and having them report every injury, regardless of how minor, that occurred during a school-sponsored activity; this resulted in an injury rate four times greater than that found under routine reporting. The McMaster studies also indicated that, where under-reporting was present, it is the less severe injuries that are going undetected (Hodgson et al., 1984).

In terms of the calculation of school injury incidence rates, it is certain that this research, as well as earlier studies, underestimates the incidence of school injuries. This is because the number of students is the common measure of injury hazard exposure used as the denominator to calculate these rates (Passmore, Gallagher & Guyer, 1989). This method assumes that children are exposed to injury hazards at school 24 hours each day, each week, and each year. Children's time at school is certainly much less than 24 hours each weekday during a less-than-full 10-month school year. It is assumed that the studies represent similar hours of time spent at school by students (in other words, hours at school are constant across the studies), thereby resulting in consistently lower rates across the research.

Students at different school levels spend different amounts of time at school; additionally, their school time and activities are allocated differently. For example, elementary schools have two recesses (free time) per day, whereas junior and senior high schools do not. Junior and senior high students may have less free time during a typical school day, but do spend more time at school extra-curricularly participating in organized sports (and athletic activities are the leading cause of injury for older students.)

The finding that elementary school students experience injuries at a higher frequency than their junior and senior counterparts is generally consistent with the research. Lenaway et al. (1992) was the only study that found junior/middle school students experiencing the highest incidence of injury; over all the studies, senior high students had the lowest incidence of injury which is consistent with the findings of this research. One possible reason for the higher injury rate among the younger students is that, while highly supervised and regulated during their lessons, they have a relatively large amount of "free time" during recess(es) and lunch when the supervision is more irregular. It was identified that elementary students experience a high proportion of their injuries over recess breaks, a program phase not present in either junior or senior high. This notion is further supported by the data which shows both that: (a) the program phases during which elementary students are most frequently injured are before/after school/noon hour and recess; and, (b) the activity accounting for the highest rate of injury among elementary students is free play. Thus, elementary students experience a higher incidence of injury and the majority of these injuries are occurring in the more uncontrolled school environments and times. Other possible reasons accounting for the higher rates among elementary students are (a) their decreased ability to assess risk (thereby exhibiting more risk-taking behaviors), and (b) the fact that younger children tend to be less agile and/or coordinated. Both of these reasons may account for the younger elementary students experiencing more injuries in their "free time."

This research showed a trend of steadily increasing injury rates for elementary students from 1987 to 1993. When injury rates were standardized by 1987 populations, the rate for elementary students again identified a steady, more marked increase over the study period. This trend is a concern which leads to more questions than answers. Was any playground equipment introduced over this time which is particularly hazardous? In conjunction with this, what type(s) of playground surfacing have been used? Does playground equipment undergo regular maintenance? Has the supervisor-to-student ratio during recess and lunch changed? Were any new activities (e.g., skiing) introduced over this period? Answers to these questions would aid in the development of prevention strategies for elementary students; for now, this trend, in conjunction with their higher incidence rates, indicates that elementary students should be targeted for injury prevention initiatives.

The downward trend in injury incidence rates for junior high students is encouraging. Senior high students showed decreasing rates of injuries from 1987 to 1991; however, injuries did increase slightly in 1993. Overall, the rate changes for senior high students were so small that it can be reasonably stated that they remained constant over the study period. The special education students, who reported a greater than 50% injury rate reduction in 1993 (after 3 years of increases), showed the most dramatic change. This large decrease is difficult to explain without knowing more about the special needs of these students and how they are integrated into the general school environment; additionally, the low Special Education student numbers limit the generalizability of these findings.

There was a very wide range in the incidence rates across the 85 schools comprising the study, from a low of 0.30 to a high of 27.21 injuries per 100 students per school year (the lowest and highest schools both being elementary). There are a variety of possible explanations for the dramatic variation in individual school injury incidences. The first is that, since the Edmonton Catholic School Board has no guidelines in place for the reporting of injuries, individual schools determine and assess what is a "reportable" injury. Some principals may have placed high importance and stringent rules on the completion of Accident Report Forms, to which their staff responded accordingly. Other principals may have placed little, if any, importance on the ARFs. Thus, the difference in reporting rates may be due to the awareness and importance placed on the reporting of injuries due to the specific culture of the school. If there were specific reporting guidelines or rules in place which were determined by and enforced at the school board level, perhaps the amount of variation in injury incidence would have been decreased.

Another possible explanation for the diversity in injury frequency among the schools is the socioeconomic situation of the students. Socioeconomic status has been shown to affect injury rates, with children of low socioeconomic status having an above average number of injuries (University of Toronto, 1993). Due to the confidentiality (school anonymity) restrictions, an analysis of geographic location/socioeconomic status versus injury frequency was not possible. Other conceivable explanations for the differences in injury rates among ECSB schools are that some schools may

be safer by virtue of: (a) greater supervision, (b) stricter supervision, (c) safer equipment, (d) better snow/ice removal, or (e) a higher grass-to-tarmac ratio.

Since denominator data for gender and age were unavailable, one can only discuss proportions and not incidence rates. Of the reported injuries, 57.7% occurred to boys and 42.3% to girls. Based on the other research (Boyce et al., 1984; Feldman et al., 1983; Lenaway et al., 1992), it was expected that boys would have a higher number (and incidence) of injuries. If one is to assume that the ratio of male-to-female students is approximately equal, this research would indicate that boys sustained a higher rate of injuries than girls. This finding would be consistent with the general childhood injury data which identify that, generally, males sustain more injuries than females (Alberta Safe Kids, 1993; Division of Injury Control, 1990; Gallagher, Finison, Guyer & Goodenough, 1984).

Gender and age are common correlates of the incidence and pattern of injuries at school and are also important factors contributing to general injury incidence rates among children and young adults (Passmore et al., 1989). It is perhaps the result of differential risk-taking or exposure to hazards, that boys are more likely than girls to experience injuries at schools. Additionally, it has been identified here and in other research that the occurrence of school injuries is not uniform over ages and grades. Children of different ages have different interactions with and amounts of exposure to hazardous situations; in other words, it is likely that developmental factors play a role (e.g., physical skill, strength, size, judgment, balance) in the occurrence of injuries.

With respect to the grade level, there were three peaks in injury rates—Grades 1, 6 and 9—with the rate for Grade 6 students being the highest. Most of the previous studies found that students in Grades 6 to 8 suffered the highest frequency of injuries, thus this study is within the general range. The reasonably high rate of injuries to Grade 1 students (3.89 injuries/100 student-years) is interesting in that it was much higher than for both kindergartners (3.33 injuries/100 student-years) and Grade 2 students (3.12 injuries/100 student-years). Kindergarten students only spend a half day in school and have little free, unsupervised time. Grade 1 students, whose age would typically be 6 to 7 years, however, are thrust into a full school day having much more uncontrolled time with less supervision, as during recesses and lunch. It could be that the young age of Grade 1 students makes them more susceptible to risk taking behaviors—being unaware of or not comprehending the potential outcomes of their actions or hazards in their environment; this, combined with the amount of uncontrolled time available to them, contributes to their higher number of injuries. By Grade 2, one could speculate that a small increase in maturity level could reduce some risk taking behaviors, as well as increase their general coordination and agility.

The times during which the most injuries occurred (10:00 to 10:59 a.m., 12:00 to 12:59 p.m., and 2:00 to 2:59 p.m.) coincided with school recess and lunch periods. While the time variable has not been analyzed in a consistent manner across school injury studies, commonalities are present. In all studies where time was reported, the noon-hour (lunch) period had the highest reported frequency of injuries (Dale et al., 1969;

Feldman et al., 1983; Lenaway et al., 1992), with timeframes encompassing recess being the second most common (Dale et al., 1969; Feldman et al., 1983), consistent with the findings of this research. The data strongly supports the notion that children, especially those in Kindergarten to Grade 3, are being injured at school most frequently during their free play or uncontrolled times.

Not surprisingly, given the above information, when the program phase at the time of injury was analyzed, the noon hour/before/after school category was the most common, followed by recess and physical education instruction. This is entirely consistent with the time component for the reported injuries. It was unfortunate that the Accident Report Forms did not distinguish between noon hour, before school and after school, instead of having these three phases as one program category. Given the manner in which the ARFs collect the data, when cross-tabulating time with program phase, assumptions must be made regarding the before/after school/noon hour category. In other words, for injuries occurring between 12:00 and 12:59 that are identified as occurring before/after school/noon hour play, the assumption is made that all of these injuries pertain to the noon hour play component. However, for kindergarten students who are only in school half a day, the before and after school components would be possible for injuries occurring between 12:00 to 12:59.

When the program category of before/after school/noon hour play was compared against the time of injury, it was found that it was difficult, and in fact impossible, to accurately attribute one of the three specific program phases to some of the times. For example, there were 59 injuries (4.7%)

occurring between 8:47 a.m. and 11:55 a.m. which were categorized as before/after school/noon hour play. It cannot be definitively stated how many correspond to before school, how many to after school, and how many to noon hour. For research purposes, it would be very beneficial if the ECSB Accident Report Form was revised to split this one program category into its three separate components: before school, after school and noon hour play. If this were done, more accurate numbers would prevail.

Consistent with the findings of Sheps and Evans (1987), elementary students were injured most often during the uncontrolled times of day and in the more uncontrolled areas of the school; in other words, during lunch and recess when in the playground and playing fields. This supports the idea of a behavioral component to their injury incidents which was alluded to earlier. Elementary students may be more prone to participating in risk-taking behaviors while in uncontrolled environments. *Uncontrolled* is defined as times or areas in which there may or may not be supervision, but the ability of the teacher to effectively intervene was limited (Sheps & Evans, 1987).

Junior and senior high students, on the other hand, were injured most frequently during physical education instruction. While none of the other studies specifically identified injuries occurring during physical education class, both Sheps and Evans (1987) and Lenaway et al. (1992) identified an increasing frequency of athletic injuries with the junior and senior grade levels. When the injury totals for physical education instruction, interscholastic game/practice and intermurals are added together, for both junior and senior high students these sport-related

categories account for 47% of all injuries. There is, thus, little doubt that athletic activities, mainly of a supervised nature, account for the single greatest number of injuries among secondary students. The finding that females in Grades 4 to 9 suffered proportionately more injuries than males during physical education instruction is interesting. As no other study reported on injuries during physical education specifically, there is nothing against which to compare this finding. Females, overall, may not have the same level of exposure to sporting activities (i.e., outside of physical education) than their male counterparts. This lack of exposure, resulting in less ability and coordination when participating in athletic activities during physical education class, may be at least a partial explanation for this phenomena.

The finding that the playing field/tarmac was the facility area with the highest reported number of injuries for elementary students was somewhat surprising. In all of the other studies where comparable numbers are given (Dale et al., 1969; Lenaway et al., 1992; Sheps & Evans, 1987; Taketa, 1984), the school playground was the location where most elementary students were injured. While the playground was the second most frequent facility area in this research, approximately 50% fewer injuries took place there in comparison to the playing field/tarmac. This is a curious outcome when considered against the other research and is probably due, at least in part, to an artifact of coding. It could be that the schools in this study do not have extensive playgrounds, thus accounting for fewer injuries. Along these same lines, children in the ECSB system may have spent more time on the playing field/tarmac and less time on the

playground as compared with students in the other studies. With respect to gender, the only other study to stratify location of injury by gender was Lenaway et al. (1992) and they also found that elementary boys had a higher injury rate on the playground than girls. This is not a surprising finding since boys, overall, have a higher propensity for injury and it could be expected that they may demonstrate more risk-taking, and perhaps aggressive, behaviors on the playground and its equipment.

The Edmonton Catholic School Board Accident Report Form specifically indicates the playground category as being "playground: climbing/play apparatus"; depending on how the playground was classified in other studies (i.e., not as specific), some of the discrepancy could be accounted for by the definition. In this same respect, this study identified the outdoor play area as "playing field/tarmac" whereas other research usually referred to the "athletic field" (Feldman et al., 1983; Lenaway et al., 1992) or "sports area" (Sheps & Evans, 1987); thus, again, some of the discrepancy in the injury numbers for facility areas between the studies could be due to differences in categorization definitions.

The finding that the gymnasium was the facility area with the greatest frequency of injuries for junior and senior high students is consistent both with the program phase (physical education instruction) accounting for the most injuries and with data from other research (Lenaway et al., 1992; Sheps & Evans, 1987). Secondary students incur the majority of their injuries while participating in athletic activities of an organized nature; all of the research on school injuries done to date supports this claim.

An interesting finding with respect to the facility area is that the ski hill was the location with the sixth highest number of injuries overall (98; 2.5%), and fifth highest for junior high students (28; 3.4%). While it is unknown how many students participated in ski trips over the study period (i.e., no denominator), one would assume that it was only a small portion of the overall study population. The ski hill, thus, appears to be a particularly injurious location, especially for females in Grades 4 to 9.

For the variable "activity at the time of injury", free play stands out as the single leading activity overall, by a fairly large margin. When broken down by grade levels, however, it was found that 94.3% of the free play injuries are incurred by elementary students (who make up 54.7% of the study population). Thus, the data again supports the idea that elementary students are at greatest risk during the more uncontrolled times of the day.

When injuries from free play and regular class instruction were removed from the "activity" database, the remaining categories were all strictly athletic activities. The sports resulting in the greatest number of injuries overall in decreasing order were soccer, basketball, running (non-P.E.), volleyball, skiing and gymnastics. Of the top five activities resulting injury for elementary, junior and senior high students, soccer is the only activity common to all three (and is, in fact, one of the top three activities at all school levels). The McMaster study (Hodgson et al., 1984) identified serious injuries sustained during specific athletic activities and found that basketball, volleyball, gymnastics, football, soccer and track and field resulted in the greatest number of serious injuries. Lenaway et al. (1992) identified football, basketball, soccer, baseball and volleyball as the sports

with the highest rates of injuries. The Lenaway et al. study, done in Boulder Valley, Colorado, reported football, for all grade levels, as the leading sport resulting in injury across all grade levels; in the Edmonton research, football was the 5th leading sport for seniors, while 8th for junior high students and 13th for elementary (tied with dodgeball and ice sports). This disparity is likely due to the cultural difference between Canadian and American schools, with much more emphasis and importance placed on football as a sport at an earlier age in the United States. The three studies (including this one) do identify basketball, soccer and volleyball as being high injury sports.

When discussing athletic activities and their injuries, the denominators—the number of children participating in each activity and the number of hours per week—are unknown, thus the true relative risks of the different sports cannot be calculated. In other words, when the numbers of injuries per athletic activity are reported, these are totals, but there is no way of knowing exactly how many students are participating in the various activities over the course of the school year. For example, skiing was responsible for 63 injuries to elementary students over the study period and softball/baseball resulted in 60. Despite the fact that both sports had almost the same number of injuries, these numbers are not necessarily reflective of the relative safety of the activities. It is likely that fewer students participated in skiing than softball/baseball, thus, the raw numbers of injuries may be somewhat misleading. The severity of injury is also an important issue; with 25% of all skiing injuries being fractures, as compared

to 10% of all softball/baseball injuries, the raw numbers alone do not give a complete picture of the magnitude of athletic activity injuries.

When reviewing the cause of injury across the research, it becomes apparent that comparisons are problematic due to the varying classifications used. Falls will be used to illustrate this point. This study identified four categories of falls: (a) fall/trip not due to an observed external factor, (b) fall or loss of balance where apparatus/equipment concerned, (c) fall/slip due to ice/snow on schoolground, and (d) fall/trip due to ice not on schoolground (see Appendix 6 for complete listing of causes). The Vancouver data simply listed "fall" (Sheps & Evans, 1987); the McMaster research used the classification of falls (excluding athletics), had a playground equipment category (which could result in falls), and other (which included bicycle riding where most injuries are the result of falling off the bike) (Feldman et al., 1983); the Tucson study did not have falls listed as a specific cause of injury (Boyce et al., 1984). This high degree of variation across the studies for the classification of cause of injury makes comparisons and trend associations virtually impossible, which is very unfortunate.

General observations, however, can be made with respect to cause. For those studies where falls were identified in some manner, they were found to be a frequent cause of the injuries, especially with the younger students. Falls are also cited in the general childhood injury literature as representing the highest rates for hospitalization and emergency room visits of all injury causes (Division of Injury Control, 1990; Gratz, 1992; Guyer & Ellers, 1990) and as accounting for 59% of all playground injuries (Rivara &

Mueller, 1987). For older students, this research and the literature point towards athletic activities as being a leading cause of injury.

One cause specific to the Edmonton study that stands out is "fall/slip due to ice or snow on schoolground." This category was added after the pilot study due to its relative frequency. The overall findings were that 6.2% of all injuries were due to slipping or falling on ice somewhere in the schoolgrounds; elementary students were the most at risk. With more attention given to clearing the schoolgrounds, especially the main walkways and play areas of ice and snow (which can hide hazards), the number of injuries may be reduced.

In terms of the body regions injured while at school, there are certainly some areas that consistently, across the research, incur more injuries. While it is difficult, once again, to make exact comparisons due to the varying classification schemes utilized by the different research teams, some generalizations can be made. This study reported that head and face injuries were most prevalent overall and for elementary students, while the fingers were the most injured body part for junior and senior high students. The head was the second and third most injured region for seniors and juniors, respectively. Generally, when assessing the research, it can be stated that the head/face area and the extremities suffer many more injuries that the central body areas.

Dale et al. (1969), in their study on injuries to elementary students, found that 64% of all injuries were to the head and face area, while 17% were to the upper extremity and 14% to the lower extremity. Sheps and Evans (1987) reported that, over all grades, 37% of the injuries were to the

head/face/forehead, 25% were to the arms/shoulders/elbows/wrist/ hands/fingers, and 15% of the injuries occurred to the lower extremity (legs/knees/ankles/ feet/toes). Feldman et al. (1983) distinguished between serious and minor injuries; the head incurred 29% and the hand/fingers 18% of the minor injuries, while the hand/fingers suffered 27% of the serious injuries. Taketa (1984) also found the head to be the most frequently injured body region over all grade levels. Lenaway et al. (1992) reported a slightly different ordering of body regions, with the wrist/hand/fingers suffering the greatest frequency of injuries overall (19%), followed by the leg/knee and then the head. For elementary students, Lenaway et al. reported that the head was the second most frequently injured region behind the wrist/hand/finger; the upper and lower extremities were the most commonly injured areas for junior and senior high students. Thus, generally it was found that the head and face areas were the most commonly injured (especially in the younger students), followed by the hand/finger and knee/ankle/leg; extremity injuries were more prevalent in older students.

This research did identify that females, over all grade levels, suffered a greater proportion of ankle injuries than males. This same finding was reported in Lenaway et al. (1992), although the body region in their study was listed as ankle/foot/toe. The higher occurrence of sprains in females within the ECSB is likely in conjunction with their higher percentage of ankle injuries.

For the injury type, again there is difficulty with exact comparisons due to the classification variability; as an example, some studies differentiate between a laceration and an abrasion while others put them in

the same category. Swelling, bumps and bruises were also represented in an inconsistent manner. Despite this variability, the studies done to date show similar patterns of injury types among school injuries. This research reported bruises, lacerations, sprains and fractures to be the most common types of injuries across all grade levels. Lenaway et al. (1992) found swelling, cut/abrasion, sprain/dislocation, and general pain to be the most frequent injuries; fractures were the fifth highest injury type. Sheps and Evans (1987) had slightly different categories and reported contusions/ abrasions/swelling to be the most common types of injuries, followed by open wounds (punctures or lacerations), sprain/strain/dislocation and fractures. Feldman et al. (1983) found swelling or bump, cut, bruise, and sprain to be the leading types of injuries in decreasing order, with fractures being the sixth leading type. Taketa (1984) grouped the injury types very broadly; abrasions/lacerations and bumps/bruises accounted for about 65% of the injuries, sprains and fractures 25% and the remaining 10% were other injuries.

What the research shows, with respect to type of injury, is that the minor injuries—cuts, bruises, swelling, bumps and abrasions—typically represent the most frequently occurring injuries. Because of the different reporting methodology and the variety of (non-medical) individuals filling out the accident report forms, it is likely that there is variability among and within the classifications. For example, the difference between a swelling and bump is really only grammatical. The difference between a swelling/ bump and bruise may be dependent upon time, as a bruise is often preceded by some swelling, and upon who is doing the reporting. Additionally, the

categories of swelling/bump and bruise may not reflect the complete description of the injury, in effect masking the true injury type, such as a fracture or dislocation.

In terms of definitively stating the type of injury, depending on when the Accident Report Form was filled out and how apparent the true injury presented, misclassification could have occurred. A displaced fracture should have been obvious to the layperson completing the form; however, a non-displaced fracture may simply have been classified as a bump or bruise, with the true diagnosis not being made until examination and subsequent x-ray by a physician. In the latter case, the actual type of injury may have gone unreported if the Accident Report Form had already been completed and sent to the school board office. It was impossible to predict how many, if any, serious injuries were masked by their more minor symptoms, as well as how many of the reported serious injuries were in fact found to be only minor on examination by a physician.

This research reported that 39.0% of all injuries within Edmonton Catholic schools are of a serious nature, which is somewhat higher than the other reported rates of 30% by Feldman et al. (1983), whose classification scheme was used as the model, and 18% by Boyce et al. (1984). As has been earlier noted, the definitions of injury severity employed by school injury studies often have been arbitrary and limited, thus making comparisons across studies difficult. The finding that for both males and females, the proportion of serious injuries increases with increasing grade levels is in conjunction with the finding that more of the older students are transported for medical assessment. The fact that females, over all grade levels,

sustained proportionately more serious injuries (based on their total number of reported injuries) than males indicates that, while females may not be incurring as many injuries as males, the ones that they do get are more serious. The higher rate of sprains, considered a serious injury, for females would be a main contributor to this finding; males and females incurred fractures at about an equal rate.

There were no other studies reporting whether a parent was notified of their child's injury. This research found that overall slightly more than three-quarters of the parents had been notified that their child had suffered some kind of injurious mishap at school. Parents of elementary students were the most frequently informed, with fewer parents being called as the grade levels increased. A possible explanation for this is that younger students may get more upset and scared when injured, hence, a parent is called as a means to help calm or soothe the child. Additionally, a young child is less likely to inform their parent(s) of exactly what happened so the school may be more apt to notify them to ensure that the parent doesn't have any misconceptions or questions about the injury incident. The older junior and senior high students may not feel that it is necessary to notify their parent at the time the injury occurred, with the schools respecting the judgment of the students.

The category identifying whether the student was transported to a hospital or medicentre/family physician was a closed-ended question requiring the individual completing the Accident Report Form to write "yes" or "no." This category had a 90% completion rate with 55% of the forms identifying transport to a hospital or medicentre/family physician. As grade

levels increased, a higher percentage of students were transported to some type of medical facility; while 49% of elementary students were taken to a hospital or medicentre/family physician, 77% of senior high students were transported to the same facilities.

Disposition identified what was done for the student and was taken from an open-ended, descriptive component at the end of the Accident Report Form (under the part of the form identified as "What was done for student"). The researcher read what had been written and then coded appropriately. This afforded the ability to distinguish between medicentre and hospital visits, as well as to identify if the student went back to class, went home or had some other outcome. The disposition component showed that overall, as well as for each school level (i.e., elementary, junior and senior), being attended to at school and then transported to a medicentre or family physician's office was the most frequent outcome for injured students. While being attended to and going back to class was the second most frequent disposition for elementary and junior students, for those in senior high the second most frequent disposition was transportation to a hospital. This concurs with the previous category (of transport to hospital or medicentre/family physician) which showed senior high students having a very high rate of physician and hospital visits.

When the disposition classifications for "attended to at school and transported to a medicentre/family physician" and "attended to at school and transported to a hospital" are added together, they give slightly lower (5 to 6%) frequencies overall and for all school levels than those reported in the previous "transport to hospital/physician" category. A possible explanation

for this is that 10% of the Accident Report Forms did not have the transport variable information completed (i.e., missing data). If the majority of these approximately 400 incomplete forms were left blank for the transport classification because the children were not taken anywhere, this discrepancy would essentially disappear.

In comparison to the other studies which reported on the treatment given to the injured student, a much higher rate of medicentre/physician visits was identified in this research. Sheps and Evans (1987) found that 21% of their students went to the hospital and 10% were sent to a physician; Feldman et al. (1983) reported 17% of the students going to the hospital/emergency room and 5% to the physician/dentist's office; Dale et al. (1969) found that 14% of the (elementary) students went to the hospital and 17% to the doctor. This research reported that 32% of all students were transported to a medicentre/family physician after being attended to at school, with 16% going to the hospital (presumably the emergency department). There are two possible explanations for this relatively higher frequency of physician/medicentre visits. The first is that medicentres themselves, or walk-in clinics as they are also called, are a new phenomena; they started emerging in the late 1980s, with larger numbers opening in the 1990s. In the early 1980s, when the other two Canadian studies (Feldman et al., 1983; Sheps & Evans, 1987) were done, there were probably very few, if any, medicentres available to which injured students could be transported. This study coincided with the emergence of the medicentres which could account for the higher number of students transported for a physician's visit.

The second possible explanation for the higher number of medicentre/physician visits could be the increased threat of liability/ lawsuits that have emerged over time. Perhaps fearful of being held accountable for possible undetected serious injuries, schools were more frequently transporting students for definitive medical diagnosis and treatment. This, combined with the increased availability of the medicentres/walk-in clinics, could account for the higher number of physician visits reported in this study. The higher overall proportion of serious injuries reported in this research offers a further explanation.

For disposition, the phrase "attended to at school," which preceded the various dispositions (i.e., to medicentre, hospital, home or back to class), was created by the researcher after the pilot study. It was meant to identify that some sort of treatment or attention was given to the student by school personnel after the injury incident. It was left in the generic form for ease of data entry and also because, in many instances, the Accident Report Form simply identified that the child had been treated but no details were given. There were completed ARFs that did outline the specific treatments administered which were, of course, dependent on the nature of the injury and included: the cleaning of wounds, band-aid application, ice, elevation, rest, and observation. It was not possible to identify which school personnel attended to the injured student since this was not supplied on the Accident Report Form. As school nurses were not present at all times, it was presumed that the teachers, coaches and administrative support personnel looked after the students. It was also unknown how many of the total number of school personnel had basic first-aid skills. Other research has

identified that only a small number of full-time teaching and support staff had first-aid training (one trained member per 205 children) (Feldman et al., 1983).

With respect to disposition of the injured student, a further consideration comes from Evans and Sheps (1987) who proposed that the outcome of choice is not the assessment of injury severity but rather the appropriate medical referral. Because school personnel are not able to make a medical diagnosis, they suggest a list of descriptors which would include what happened to cause the injury, in addition to statements about the child's functional state shortly after the injury occurred. They proposed this list as both a tool to aid school personnel in assessing the injured student and as a starting point for future research. This is an interesting and perhaps useful suggestion. School personnel may feel more at ease dealing with injuries if there were some defined criteria outlining what is recommended for the injured student. A list such as this may reduce the number of unnecessary physician or emergency room visits. Irrespective of this list, it would be useful for future prospective research to include the medical diagnosis and treatment of the injured child who is referred to a medical facility. This would provide beneficial information regarding what types of injuries are being referred; along with the information already collected, a clearer, more precise picture of injury severity would emerge.

A final issue to be addressed is the validity of the data presented in this research. An issue for this research is the fact that the Edmonton Catholic School Board has no guidelines in place for the reporting of injuries. Individual schools, as well as individuals within the schools, were

left to determine what injuries would be reported, thus the concern of measurement bias was present. Because the reporting of injuries was dependent on the judgment of individuals, and influenced by the culture of their schools, vast differences in the number of reported injuries existed between the schools. Some schools may have selected only the most serious injuries as reportable, while other schools may have reported all injuries no matter how minor, with many schools falling somewhere in the continuum. This is a problem that would have been present in all of the retrospective studies on school injuries, but perhaps was less of an issue for those done in schools where specific reporting guidelines were in place. Given that the under-reporting of injuries was strongly suspected in the retrospective studies, this measurement bias may have been responsible, at least in part, for lowering the reported rate of school injuries when compared to the prospective studies, in which all injuries were reported.

The "type of injury" category also leads to questions regarding the validity of the data. School personnel completed the Accident Report Form. For the minor injuries, such as lacerations, abrasions and punctures, the diagnosis would be relatively simple, straightforward and error-free. However, the serious injuries are more difficult to correctly diagnose without medical assessment. The high proportion of serious injuries reported in this research may be an over-estimate of their actual occurrence (for example, if school personnel were checking off the most serious *suspected* injury). It is unknown how many of the Accident Report Forms were filled out or amended after a medical diagnosis had been made, but this would certainly have provided more factual information.

Chapter 6

CONCLUSIONS

As this research and the literature shows, school injuries are a significant school health issue. This study reported that nearly 5% of all elementary students were injured while at school, most often during their free time at noon hour and recesses. Not surprisingly, the playing field/tarmac and the playground were the locations where these young children were incurring most of their injuries, and falls of some sort were a main cause. The older students, those in junior and senior high, experienced the majority of their injuries during athletic activities, both organized and unorganized. Physical education instruction was the most frequent program phase of injury for these older students; basketball, soccer and volleyball were the three sports resulting in the greatest number of injuries.

In terms of the anatomical distribution of injuries, the head sustained a high rate of injuries over all grade levels, however, the rate for elementary students was about twice that of their junior and senior high counterparts. The older students overall incurred more injuries to their extremities, mainly the fingers, ankles and knees. For all three school levels, when injuries to the head and face were combined, their totals accounted for the largest number of injuries.

Minor injuries, including bruises, lacerations and abrasions, were found to be most common among elementary students, accounting for approximately 66% of all injuries. Junior and senior high students suffered

proportionately more serious injuries, namely fractures, sprains, strains and concussions, accounting for approximately 50% of the injuries. Fractures were the third leading type of injury for all school levels, occurring slightly more in junior high students. In conjunction with these findings, it was not surprising to find that junior and senior high students were more frequently transported for medical referral and treatment.

Most parents and guardians are naturally protective of children under their direct care, and they invest enormous trust in school authorities to maintain the safety of their children while attending school. Yet, schools present a variety of hazards for injury. Risks can vary considerably as students move through a typical school day from supervised, structured, and sedentary environments in classrooms, to the use of potentially harmful substances, tools and materials in science laboratories and industrial arts shops, to physical, competitive, and, at times, aggressive activity in gymnasiums and on playing fields, to relatively unsupervised play during recess and lunch periods.

School boards, as well as health departments that provide school health services, have a responsibility to understand the hazards found at school and their relationship to school injuries. The research done to date clearly indicates that playing fields, playgrounds and athletic activities require greater attention if school injuries are to be prevented. This research was undertaken to identify patterns of injury in a private, urban school district and to ascertain subgroups of students that are at an increased risk of injury occurrence. It is hoped that this study may stimulate further

investigation of school-related injuries and foster the development of interventions designed to lower the incidence of such injuries.

Chapter 7

RECOMMENDATIONS

Data Collection Recommendations

Data Collection Recommendations Specific to the Edmonton Catholic School Board

There are some measures that the Edmonton Catholic School Board could take to improve the collection of data within their system. The first would be to compile their Accident Report Forms on a school year basis so that injury data and enrollment data would correspond. The ECSB also needs to develop specific reporting guidelines for injuries. Their current system provides no directives to the schools and, thus, the schools are left to decide which injuries are reportable and which are not.

A further recommendation would be for the School Board to enter the information on their Accident Report Forms into a database on a regular basis. The time it would take to input individual forms as they come into the School Board office would be minimal; once they accumulate over the year(s), the task becomes quite onerous. With the data entered, the School Board could perform some basic analyses annually.

The Accident Report Form itself could be improved to ease data collection and to provide more accurate measures. Under "Facility Area," it would be beneficial to separate out the playing field and tarmac; additionally, identifying grass playing fields from gravel playing fields would provide useful information. Under "Probable Direct Cause", falls and athletic

activities could be made into major headings and then sub-categorized (according to the classifications on the current form). With this, the two most common causes of injury would be made more apparent and their specific details would still be present.

As identified earlier, under "Program Phase" it would be very useful if noon hour play were made its own entry, as opposed to being a part of "before/after school/noon hour play." Under the "Activity" component, re-titling the heading "Athletic Activity (if applicable)" would indicate that only athletic-related injuries need to be identified here. Additionally, the list of activities requires updating to include bicycling, skiing, snow activities (e.g., toboganning, sledding, snow-shoeing, etc.), and walking. Bordenball and dance could be eliminated.

The final portion of the ARF, "What was done for student," could be improved by eliminating the line that states, "Was child transported to hospital/medicentre? By Car:__ By Ambulance:__." In its place would be five possible options to check off: "Attended to at school and transported to hospital"; "Attended to at school and transported for physician assessment"; "Attended to at school and sent home"; "Attended to at school and sent back to class"; and "Other." This question would go from an open-ended to a closed-ended format, making data collection much easier and more reliable. A blank line could remain for school personnel to identify what treatments were given at school; for research purposes, the listing of common treatments (rest, ice, etc.) which could then be checked off would be optimal.

General Data Collection Recommendations

One of the essential problems with the descriptive research done to date on school injuries is their lack of methodological consistency. The various studies all use different definitions and classifications which make comparisons across the research difficult and, in some instances, virtually impossible. Inherent in the need for methodological consistency is the necessity for the development and utilization of an injury reporting form that is clear, concise, comprehensive and easy to complete. This form could then be used for all subsequent prospective studies on school injuries thus providing the collection of the same basic data. An additional requirement would be the formation of specific reporting criteria which would identify reportable injuries. These reporting standards would need to be adopted and enforced by the school district(s) and schools comprising the studies.

A goal to set would be the development of a standard "Injury Reporting Form" for schools to be utilized nationally, in both the public and private school sector. If this form was based on the research done to date and used at all schools across the country, this would provide a level of consistency between future (Canadian) studies, allow comparisons, and, generally, aid research on school injuries and their prevention. Under-reporting may still be an issue, due to the variation of importance placed upon the completion of the injury reporting forms. There would need to be an on-going, aggressive campaign directed at schools highlighting the importance of reporting injuries according to the reporting guidelines. A national approach would require more reliable reporting of school injuries than the research has shown to date, as well as a national body or interest group to undertake

this task. While this national approach may be somewhat utopian, school boards at the local (municipal and provincial) levels could work towards improving their school injury reporting schemes to make them more reliable and amenable to data collection and analysis.

Injury Prevention Recommendations

The Edmonton data identified that elementary students are much more at risk during uncontrolled times and in uncontrolled environments; in other words, during recess and lunch while out in the playing fields and playground. An increase in the student-to-supervisor ratio during these periods, as well as more structured activities for these times, may be necessary to prevent injuries from occurring. An analysis of playground surfacing, especially under playground equipment/apparatus, would also be useful, as inadequate or improper surfacing can add to the injury problem (Langley & Crosado, 1982).

The older junior and senior high students incurred most of their injuries during athletic activities, both supervised (physical education class, interscholastic game/practice, intramurals) and unsupervised. Proper warm-up is important in the prevention of some athletic injuries (e.g., strains) and students need to be made aware of the importance of this. Additionally, skiing, which resulted in a large proportion of fractures, should be reviewed as to its inclusion in the school curriculum. The level of the students' skiing ability is likely very broad; given this notion, and the likelihood for

students to "show off" or race when in peer groups, as well as the supervisory difficulties on a ski hill, skiing appears to be a poor choice for a school activity.

At this point, caution must be exercised when recommending specific injury prevention interventions, as no research has been identified on the efficacy of any specific school-based strategies. Intuitively, the elimination of potential hazards from the school environment, a passive protective measure, would be expected to reduce injuries. Further research will be necessary before the true effect of this is known. The studies done to date have all focused on the epidemiology of school injuries; perhaps the next phase of research will begin to develop and analyze strategies for the prevention of these injuries.

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Appendix 1

Accident Report Form

(attached)

APPENDIX I

ACCIDENT REPORT FORM

School: _____ Date Form Completed: _____

Name of Student: _____ Alberta Health Care #: _____

Student I.D. #: _____ Sex: [ ] Male [ ] Female

Age: _____ Grade: _____ Date & Time of Accident: _____

INDICATE THE ONE (OR MORE) MOST APPROPRIATE STATEMENT(S) FROM EACH OF THE FOLLOWING SECTIONS:

1. Body Region(s) Injured:

[ ] Head	[ ] Upper Arm	[ ] Back
[ ] Face	[ ] Elbow	[ ] Buttocks
[ ] Nose	[ ] Forearm	[ ] Groin
[ ] Eye	[ ] Wrist	[ ] Thigh
[ ] Ear	[ ] Hand	[ ] Knee
[ ] Teeth	[ ] Finger	[ ] Lower Leg
[ ] Neck	[ ] Chest	[ ] Ankle
[ ] Shoulder	[ ] Abdomen	[ ] Foot

2. Type of Injury:

[ ] Abrasion - scrape.
[ ] Burn.
[ ] Bone Bruise - swelling and/or discoloration of bony area.
[ ] Concussion - temporary loss of orientation or unconsciousness.
[ ] Dislocation/separation - deformity of a joint.
[ ] Fracture.
[ ] Laceration/incision/puncture - an open wound.
[ ] Muscle strain (pull or tear) - due to use rather than blow.
[ ] Nose bleed.
[ ] Sprain - twisting or moving of a joint beyond normal range.
[ ] Teeth - loosened or broken.
[ ] Other: _____

3. Facility Area:

[ ] Gymnasium	[ ] Pool
[ ] Playing Field/Tarmac	[ ] Rink
[ ] Classroom/Lab	[ ] Locker Room/Shower
[ ] Playground-climbing/ play apparatus	[ ] In transit to or from school
[ ] Hallway/Stairway	
[ ] Other: _____	

4. Probable Direct Cause:

[ ] Accidental collision between participants.
[ ] Blow delivered by an object (ball, bat, etc.).
[ ] Body contact (not considered a collision) in the normal course of an activity.
[ ] Carelessness on part of pupil.
[ ] Fall/trip not due to an observed external factor.
[ ] Fall or loss of balance where apparatus concerned.
[ ] No clear or apparent cause.
[ ] Obstruction on playing area (object or spectator).
[ ] Strain or overexertion.
[ ] Other: _____

(over...)

5. Program Phase:

[ ] Before/after school, noon hour play
[ ] Classroom/Lab instruction
[ ] Field Trip - out of school
[ ] Interscholastic game/practice
[ ] Intramural/House League
[ ] Physical Education instruction
[ ] Recess
[ ] Other: _____

6. Activity:

[ ] Aquatics
[ ] Basketball
[ ] Bordenball
[ ] Dance
[ ] European Handball, Fieldball, Field Hockey
[ ] Floor Hockey
[ ] Football (tackle)
[ ] Football (flag, touch)
[ ] Free Play - spontaneous activity
[ ] Games Lesson
[ ] Gymnastics (apparatus)
[ ] Gymnastics (free exercise, tumbling)
[ ] Ice Hockey
[ ] Ice Sports (other)
[ ] Organized activity - recess, noon hour
[ ] Racquet Games
[ ] Soccer or Speedball
[ ] Softball or Baseball
[ ] Track & Field/Cross Country
[ ] Volleyball
[ ] Wrestling & Personal Defence
[ ] Misc. Indoor or outdoor activities
Specify: _____
_____
_____

7. Brief Description of Accident:

_____
_____
_____
_____
_____

8. What Was Done For Student: (who attended, who was contacted, where sent and how?)

Was Parent Notified? Yes ____ No ____
Was child transported to Hospital/Medicentre? ____ By Car: ____ By Ambulance: ____

_____
_____
_____
_____
_____
_____
_____

Principal: _____ Teacher in Attendance: _____
Signature Signature

Witness(es): _____
Signature

3 COPIES
2 - Dorothy LeClair - Administration Centre
1 - Retain at School

Revised January 1992

Appendix 2

Grade Level Codes

00	Kindergarten (ECS)
01	Grade 1
02	Grade 2
03	Grade 3
04	Grade 4
05	Grade 5
06	Grade 6
07	Grade 7
08	Grade 8
09	Grade 9
10	Grade 10
11	Grade 11
12	Grade 12
13	LC
14	EE1
15	EE2
16	EE3

Note. Codes 13-16 are Special Education grades

Appendix 3

Body Region(s) Injured Codes

101	Head
102	Face
103	Nose
104	Eye
105	Ear
106	Teeth
107	Neck
108	Shoulder
109	Upper Arm
110	Elbow
111	Forearm
112	Wrist
113	Hand
114	Finger
115	Chest (incl. ribs)
116	Abdomen
117	Back
118	Buttocks/Hip
119	Groin
120	Thigh
121	Knee
122	Lower Leg
123	Ankle
124	Foot
125	Tongue
126	Not applicable - predisposing condition - drugs - etc.
127	Other (specify)

Appendix 4

Type (Nature) of Injury Codes

201 Abrasion - scrape

202 Burn

203 Bone bruise - swelling and/or discoloration of bony area

204 Concussion - temp. loss of orientation or unconsciousness

205 Dislocation/separation - deformity of a joint

206 Fracture

207 Laceration/incision/puncture - an open wound

208 Muscle strain (pull or tear) - due to use rather than blow

209 Nose bleed

210 Sprain - twisting or moving of joint beyond normal range

211 Teeth - loosened or broken

212 Pinching (of skin, appendage)

213 Winded/Dizzy

214 Fainting/Passed out/Shock

215 Eye irritation/double vision

216 Predisposing condition

217 Unknown

218 Headache/bump on head/general head soreness

219 No visible injury or complaint by student

220 No visible injury, pain only (no clear injury type)

225 Other (specify)

Appendix 5

Facility Area Codes

301 Gymnasium/weight room/auditorium

302 Playing field/tarmac

303 Classroom/lab

304 Playground (incl. climbing/play apparatus)

305 Hallway/stairway

306 Pool

307 Rink

308 Locker room/shower

309 In transit to or from school

310 In transit to or from field trip

311 Cafeteria

312 Ski hill

313 Park (field trip)

314 Bike/rollerblade trail (field trip)

315 Schoolgrounds (not playing field or playground)

316 Other (specify)

Appendix 6

Probable Direct Cause of Injury Codes

401 Accidental collision between participants

402 Blow delivered by an object (ball, bat. etc.)

403 Body contact (not considered a collision) in the normal course of an activity

404 Carelessness on part of pupil

405 Fall/trip not due to an observed external factor

406 Fall or loss of balance where apparatus/equipment concerned

407 No clear or apparent cause

408 Obstruction on playing area (object or spectator)

409 Strain or overexertion

410 Sharp object

411 Fall/slip due to ice/snow on schoolground (playground, sidewalk, etc.)

412 Jump/improper landing from equipment/apparatus

413 Aggressive behaviour/fight

414 Fall/trip due to ice not on schoolground

415 Predisposing condition (e.g., seizures)

416 Accidental collision between student and object (e.g., wall, pole, etc.)

417 Students "rough-housing"; horseplay

420 Other (specify)

Appendix 7

Program Phase Codes

501 Before/after school, noon hour play

502 Classroom/lab instruction

503 Field trip - out of school

504 Interscholastic game/practice

505 Intramural/house league

506 Physical education instruction

507 Recess

508 Free time/spare block/class change

509 School activity day/playday, etc.

510 Other (specify)

Appendix 8

Activity at Time of Injury Codes

601	Aquatics
602	Basketball
603	Bordenball
604	Cycling
605	Dance
606	European handball/fieldball/field hockey
607	Floor hockey/scrimmage/ball hockey
608	Football (tackle)
609	Football (flag, touch)
610	Free play - spontaneous activity
611	Games lesson
612	Gymnastics (apparatus)
613	Gymnastics (free exercise, tumbling)
614	Ice hockey
615	Ice sports (other)
616	Jogging/running
617	Organized activity - recess, noon hour
618	Racquet games
619	Rollerblading
620	Rugby
621	Skiing
622	Soccer/speedball
623	Softball/baseball
624	Track & field/cross country
625	Volleyball
626	Walking
627	Weight training/lifting
628	Wrestling & personal defense
629	Toboganning/sledding/ snow activities (e.g., snow-shoeing)
630	Running (not sport or P.E.-related)
631	Regular class instruction/participation (non-sport)
632	Fitness testing/aerobics
633	Dodgeball
635	Other (specify)

Appendix 9

Disposition of Injured Student Codes

1	Attended to at school, transport to medicentre
2	Attended to at school, transport to hospital
3	Attended to at school, went home
4	Attended to at school, back to class
5	Unknown
6	Not attended to at school, own transport to medicentre/hospital
7	School/teacher not informed of injury by student, student continued normal activity (school notified at later date by parent, guardian or student)
9	Other